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Using eID to improve ewe performance

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Abstract

Ewe condition has a profound effect on many parts of the production cycle. Monitoring ewes' bodyweight and condition score gives producers the opportunity to improve production and welfare outcomes on an individual animal, flock and industry basis. Currently, manual condition scoring of a portion of ewes in the flock is still critical to manage ewes. Electronic Identification and its associated technologies are now readily available to producers, but many are unsure of how it can be best used in their commercial sheep enterprises. In order to address this, ewes were monitored over 18 months on three farms in western Victoria. Using the approaches developed for the PDS resulted in some production increases on some occasions, showing that these practices can be implemented on farms and provide benefits. Producers also benefited from practicing utilising eID on their farms, not least by using it to test the effect of their management strategies, increasing their confidence in making changes on a larger scale. However, there were also limitations and barriers to adoption. Further resources and support tools would assist producers in utilising eID effectively in commercial enterprises.

Executive summary

Ewe bodyweight and condition have a significant effect on conception, lamb marking percentage and lamb performance to weaning and beyond. For example, it has been shown that a 1kg increase in ewe bodyweight (up to condition score 3) will increase lamb marking by around 1.2% (Oldham et al, 2011). Optimising ewe management can also reduce the incidence of other costly diseases or syndromes; for example pregnancy toxaemia (estimated cost $16m, or $1,200 per flock (Lane et al, 2015)); and perinatal lamb mortality (estimated cost $540M (or over $43,000 per flock) per annum (Lane et al, 2015)). Furthermore, ewe management contributes significantly to bodyweight and health of weaners via ewe lactation affecting lamb weight and growth. Welfare of ewes and lambs is another major issue for producers and consumers, and effective monitoring of individual ewes will improve welfare. Therefore, more precise management of ewe condition has the potential to be extremely beneficial.

Currently, management of ewe condition often entails a subset of ewes in a mob being manually condition scored, and the whole mob managed based on the results. This is potentially a barrier to adoption of management as it requires operators to be competent in the skill of condition scoring, takes time, and does not allow for the variation in ewe condition within a mob. If eID could be used to automate condition scoring via the relationship between condition score and bodyweight for each ewe, it would reduce the subjectivity and variability between operators and the time involved.

Coinciding with these management recommendations, electronic ear tags became mandatory in Victorian sheep born after January 2017. Electronic ID (eID) and associated software and hardware now have the potential to make monitoring and managing individual animals easier and more accurate by allowing producers to objectively monitor individual ewe weight change, as well as outcomes such as pregnancy results of individual ewes. Many producers, including some in this PDS group, have purchased or received grants for equipment such as scales and wands/tag readers which enable them to capture data. However, some of these producers are unsure which data they should collect, or how data can increase the profitability and/or productivity of their flocks. Others are unsure whether to invest in monitoring equipment.

The aim of this project was for producers to become confident in the use of technology associated with eID, and use the data generated by eID to improve the productivity of their ewes and therefore profitability of their sheep enterprise. An attempt was also made to predict the standard reference weight of ewes, so that eID and automated weighing could be used to identify ewes requiring preferential feeding. This project also investigated the barriers to effective adoption and use of eID technology to change ewe management in commercial sheep enterprises.

Ewes on three farms (one Composite, two Merino) in western Victoria, in the Shelford and Skipton areas, were monitored for 18 months, between weaning 2018, and pregnancy scanning in 2020. The total number of ewes on these farms at the start of the project was around 13,600, plus replacements. Ewes were enrolled into a ‘Control’ or ‘Monitor’ mob; ewes in the Control mob were not regularly weighed or condition scored, and lower body condition score ewes were not preferentially fed before joining; ewes in the Monitor mob were monitored through regular weighing (and condition scoring on two of the three farms) when ewes were already yarded, and ewes in low body condition score during the summer were preferentially fed before joining. Individual scanning results of ewes, and mob marking and weaning percentages were recorded as appropriate on each farm.

Using the approaches developed for the PDS resulted in some weight differences between Control and Monitor ewes and differences in scanning and marking results during the project, showing that these practices can give benefits for ewe management. This suggests that regular monitoring does improve management of ewes, through increased awareness of ewe bodyweight or condition. There were less differences between the Control and Monitor ewes at the end of the project than during it, when the ewes were under more nutritional pressure, during late pregnancy or lactation. Therefore, if monitoring is continued even during favourable seasons, producers can have more confidence around opportunistic decisions about the use of surplus feed. Thus, the use of eID can benefit not just one enterprise, but the whole farm system, for example pasture utilisation.

On the occasions when eID-based differential condition management was used, lower condition score ewes in the Monitor group were drafted off for preferential feeding in January. By using records generated via eID, it was shown that these ewes had already been lighter at weaning; therefore, there is a benefit in drafting ewes off for preferential feeding at weaning, when pasture is better quality and therefore supplementary feeding is cheaper. On the farm which preferentially fed ewes in the second summer of the trial, the 'Light' ewes had had a higher scanning percentage than the 'Heavy' ewes the year before, indicating they may have reared more kilograms of lamb per ewe than the heavy ewes. These applications of eID allow ewe performance to be examined retrospectively, and the effects of management changes to be quantified.

To address the automation of condition scoring by establishing a relationship between condition score and bodyweight for each ewe, an algorithm was developed to link this data in individual ewes, and calculate an individual Standard Reference Weight for each ewe. The accuracy of this algorithm was variable but promising. This is a valuable finding for the industry as it shows that for it to be successful, linking automated weighing (facilitated by eID) to practical ewe management requires ongoing research and implementation at multiple levels, including developing reliable algorithms and linking these to clear, practical farmer decision support tools.

Producers gained skills and knowledge in using eID-related equipment and what needs to be done in practical terms, in order for it to be implemented on farm. Monitoring ewes returned a positive return on investment (2.5-5 times ROI) in 3 of 6 occasions; of the other 3 occasions, external factors (excellent season and loss of unexpected number of lambs in one mob) may have affected the results. This demonstrates the complex and multifactorial nature of farm enterprises.

Electronic ID can be used as a tool to allow producers to test and conduct a cost benefit analysis on strategies, to assist producers to make changes. Furthermore, whilst electronic ID has a role in monitoring ewes in commercial enterprises, it is one part of a complex system and other factors are still very important. This project also highlighted the potential benefits of further education and resources on using eID technology, to assist producers to better utilise the technology.

Abbreviations:

eID, electronic identification

SRW, Standard Reference Weight

CS, Condition Score

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1 Background

1.1 Introduction

1.1.1 The importance of ewe bodyweight

Ewe bodyweight and condition have a significant effect on conception, lamb marking percentage and lamb performance to weaning and beyond. For example, it has been shown that a 1kg increase in ewe bodyweight (up to condition score 3) will increase lamb marking by around 1.2% (Oldham *et al.* 2011). Appropriate nutritional management of ewes during pregnancy also reduces the incidence of diseases such as pregnancy toxaemia, which has been estimated to cost the industry $16m, or $1,200 per flock (Lane et al, 2015).

Ewe weight and body condition also affect lamb mortality. Perinatal mortality has been estimated by Lane *et* al to be the most costly disease to the sheep industry, at $540M (or over $43,000 per flock) per annum. One of the most common causes of neonatal mortality is the Starvation/Mismothering/Exposure (SEM) complex (Hinch and Brien 2014); in one study, by Luff (1980), SEM was found to be the cause of 58.2% of deaths. One of the contributors to this complex is low lamb birthweight, which is directly related to ewe body condition (Oldham *et al.* 2011). Therefore, more precise management of ewe condition has the potential to be extremely profitable in commercial flocks.

Nutritional management of ewes also contributes significantly to bodyweight and health of weaners through the effect of ewes' lactation on lamb weight and growth. It has been estimated that the net gain of reducing weaner ill thrift and mortality to the recommended figure of 4% in all flocks would be $40m (Lane *et al.* 2015). Welfare of ewes and lambs is also of concern for producers and consumers, and effective monitoring of ewes will improve welfare through reduction of nutrition-related animal health problems and reducing mortalities.

Hence, ewe bodyweight and condition affect many parts of the production cycle. Monitoring ewes throughout the production cycle allows producers to ensure they are receiving adequate nutrition, and identify and appropriately manage ewes in suboptimal condition, or over conditioned ewes, thereby improving outcomes on an individual animal, flock and industry basis.

Monitoring of ewes has traditionally been done by condition scoring or weighing a sample of ewes and managing the mob based on these observations. The number of producers condition scoring ewes increased after the delivery of the Lifetime Ewe Project but, anecdotally, some producers have since discontinued condition scoring because of the time and skill involved (for example, if some staff are not trained in condition scoring). Furthermore, using a 'mob average' figure to manage ewes does not allow for the variability in condition score within a mob, and therefore the variability of expected outcomes for ewes and their lambs.

1.1.2 Use of electronic identification in commercial sheep enterprises

Electronic identification (eID) has been used to identify and collect data on animals in stud flocks for some time and is considered a mainstay in such enterprises. In terms of the wider sheep industry, electronic ear tags have been mandatory in all sheep and goats born in Victoria after January 1, 2017,

to improve traceability of livestock. Electronic ID and associated software and hardware also have the potential to make monitoring and managing individual animals easier and more accurate by allowing producers to objectively monitor individual ewe weight, as well as record individual performance outcomes such as pregnancy scanning result. Whilst collection and recording of much of this data (for example, scanning result, wet/dry status at marking) is possible without eID, by physically identifying ewes, electronic ID makes this process easier for producers, as long as they are comfortable with using the technology. This is significant because making identification of these ewes easier means that the uptake of practices (such as identifying twin-bearing or dry ewes) by the industry is likely to be more widespread. This was one of the barriers with regards to more widespread use of eID in the sheep industry identified in a report by Pattinson (2013).

There have been various reports published on implementing eID on farms. The report by Pattinson (2013) on a workshop on 'On-farm application and value of eID for the sheep industry' identified a number of benefits for commercial sheep producers, including time and labour savings, improved Occupational Health & Safety (via less application of additional tags, manual drafting etc), and by its very nature of 'introducing a culture of measurement' on farms and in the industry. However, a 2019 MLA report on a desktop modelling study by Dickson stated that commercial producers are reluctant to use eID due to "limited information relating to the long-term effects on flock structure and profitability of alternative management decisions guided by the information collected using eID". As Dickson stated, when compared with studs, commercial producers have a different focus and different goals for using electronic ID, and this, along with the scale of enterprises, brings unique challenges.

Producers in this PDS had expressed an interest in, or are challenged by, maximising ewe reproductive performance, particularly the management of ewes in the periparturient period. These producers are excited or challenged by the potential of eID and have a strong interest in using it to improve their efficiency in managing ewes to improve their welfare and reproductive performance.

Many sheep producers, including some in this group, have purchased or received grants for equipment such as scales and electronic tag readers which enable them to use electronic ID. However, some producers are unsure which data they should collect, or how to use this data to increase the profitability and/or productivity of their flocks. Others are unsure whether to invest in equipment, or which equipment they should purchase. Furthermore, the large numbers of sheep on some farms make collection and utilisation of data a logistically challenging, and potentially time-consuming task. In short, there is still a need to support producers in identifying which production challenges eID could be used to solve, and how eID could be used to solve them.

The producers aimed to address the complex issue of how electronic ID can be utilised to aid monitoring of a large number of animals in a commercial enterprise, where time is often scarce and labour limiting. This necessitates efficiency in gathering of data, as well as its application. The report by Pattinson sets the scene, and the modelling by Dickson in 2019 helps to bridge the gap that prevents wider uptake of electronic ID in commercial sheep enterprises; the next step is now to implement the use of eID on these farms, to determine logistical barriers to uptake, and what can be improved.

2 Project objectives

The project objectives were:

By January 2021, in south west Victoria:

1. At least 20 core and observer producers will gain an understanding of, and confidence with, eID-related technology after attending a workshop; the core producers will consolidate these skills by repeating them at subsequent husbandry events
2. The bodyweight of ewes on at least 3 farms will be monitored for one year, and technology associated with eID will enable producers to:
   - Identify and appropriately manage any low bodyweight ewes or those losing weight
   - Find differences in production of ewes and mortality of ewes and lambs between monitored and control mobs
   - Demonstrate a relationship between bodyweight & subsequent reproductive performance
   - Analyse lamb production of monitored and control ewes
   - Conduct a cost benefit analysis of purchasing eID-related software/hardware and monitoring ewes
3. A field day attended by at least 30 producers will be conducted, and regular written and verbal communications will be produced to give updates on trial results
4. Demonstrate that at least 70% of core and observer producers are more confident in the use of eID-related technology, as shown by an exit survey.

3 Methodology

3.1 Farm details

The project was conducted between weaning in 2018 and pregnancy scanning in 2020 on each of three farms; one Composite, and two Merino. The farms varied in size, both in terms of area, and number of sheep (Table 1). The two Merino farms also have a sizeable cropping enterprise, which was significant as it affected the time available to spend monitoring ewes at certain times of the year.

Table 1. Breed and number of ewes, effective land area at the commencement of the PDS on the three host sites, and the number and age group of ewes enrolled

Farm	Breed	No. ewes on farm	Approx. grazing area (ha)	Approx. no. ewes enrolled (x2)	Ewe parity & age at trial start
1	Composite	2,200	1050	210	Weaned 1st lamb (1yo)
2	Merino	8,500	2780	160	Weaned 1st lamb (2yo)
3	Merino	2,900	1800	150	Weaned 2nd lamb (3yo)

3.2 Project design

Shortly after weaning in 2018, ewes on each farm were enrolled into either a ‘Control’ or a ‘Monitor’ mob. Ewes were tagged with Shearwell electronic ID tags, donated by Agriculture Victoria, if they did not already have electronic tags. On each farm, the control and monitor mobs had the same number

of ewes (150-210, as elected by the producer) of the same breed, age and parity; however, mobs between farms varied. This allowed producers to choose a group of ewes to monitor based on their situation, previous experiences and challenges.

Ewes in the control mob were weighed at the start and end of the trial (weaning 2018 & pregnancy scanning 2020); for the rest of the trial period they were treated as per the usual monitoring and management practices on each farm, though the producers on the host sites did weigh them at some other occasions which allowed a comparison of bodyweights with those of the monitor mob. Ewes in the monitor mob were weighed at husbandry events for the duration of the trial (weaning, scanning, pre-lambing, lamb marking, weaning, pre-joining, etc, refer to Table 2), and using the PDS's approach to the use of eID, their weights recorded against their eID. All three farms used a panel reader or XRS Stick Reader, Tru-Test XR5000 and autodrafting weigh crate to obtain and record these values. Condition scores of individual ewes were also recorded against ewes' eIDs on two of the three farms. In response to eID-facilitated monitoring, ewes in the monitor mob were preferentially fed before joining in either the first or second summer of the trial. The same parameters were recorded as for control ewes. Ewes were lambed separately from the Control ewes where possible.

Measurements included:

- Number of ewes present at each weighing event
- Ewe bodyweight (monitors at each observation, controls at start and end)
- Individual or mob average condition score
- Scanning result of ewes
- Number of dry ewes at marking
- Number of lambs present at marking & weaning and average bodyweight of lambs at these times

Table 2. Measurements taken of Monitor ewes (and lambs) and their timing

Event	Wean 2018	January 2019	Pre-join 2019	Scan 2019	Pre-lamb	Marking	Weaning 2019	January 2020	Pre-join 2020	Scan 2020
Activities	Tag ewes	Weigh ewes[A]	Weigh ewes[A]	Weigh ewes[A]	Weigh ewes[A]	Weigh ewes[A]	Weigh ewes[A]	Weigh ewes[A]	Weigh ewes[A]	Weigh ewes[A]
	Weigh and condition score ewes	Draft off Light ewes for preferential feeding (Farms 1 & 2)		Record scanning result		Wet/dry ewes	Weigh lambs	Draft off Light ewes for preferential feeding (Farm 3)		Record scan result
						Count lambs	Draft off Light ewes for preferential feeding (Farm 3)			

[A]Ewes were also condition scored on Farms 2 & 3. Ewes were also counted via the number of weights.

Mean bodyweights and condition scores of the 'light' and 'heavy' monitor and control ewes (where this group was weighed) were compared, along with the scanning and marking percentages and lamb

weights where possible. Bodyweights were compared for statistical significance where appropriate. Microsoft Excel and R were used to complete these analyses.

3.2.1 Calculating an individual Standard Reference Weight (SRW) for ewes

Condition scoring has been shown to be a good assessment of ewes' fat and muscle reserves (Van Burgel *et al.* 2011). This is a skill which currently cannot be automated. There is a relationship between bodyweight and condition score; Van Burgel *et al.* found that in Merino flocks, the relationship between these two measurements was an average of 0.19 times the Standard Reference Weight of the flock, which indicates that frame size of the ewes has a bearing on this relationship. At the first visit of this PDS, the variability of bodyweight within a condition score (sometimes more than 26kg on each farm) showed that there are a range of frame sizes within a flock; therefore, as part of demonstrating the use of eID in commercial enterprises in this PDS, an attempt was made to more accurately predict a ewe's individual Standard Reference Weight based on her frame size:

- When ewes were weighed and condition scored to 0.25 of a score at the first visit, their bodyweight and condition score were used to estimate their likely frame size:
    - Ewes with bodyweights in the lowest tercile (<33.3%) within a condition score were said to be small framed;
    - Ewes in the middle tercile (33.3%-66.6%) were said to be of medium frame, and
    - Ewes in the heaviest tercile of bodyweight within a condition score (>66.6%) were said to be large framed.
- A number of kilograms of bodyweight was then allocated to the small, medium and large frame sizes.
- One condition score datapoint was used alongside this information to estimate a ewe's likely weight at condition score 3.
- Following this, if fleece weight was estimated at each time point based on data from Campbell *et al* (2011), a change in a ewes' liveweight could then be used to estimate her change in condition score.

3.2.2 Cost benefit analysis

A partial budget of weighing was carried out by comparing the scanning or marking percentage of the control and monitor ewes within the same farm in the same year, using the following method:

- Time: to calculate time involved in weighing ewes;
    - The time stamp function of the XR was used where possible; this notes the time when each ewe was weighed and therefore the total time spent weighing. Where this was not available, the time taken was assumed based on other visits; for the first visit, which involved allocating ewes to treatment groups and tagging ewes if necessary, a longer time was used.
    - Only the time spent weighing was included (i.e. not time spent mustering etc) as ewes were already yarded for another husbandry procedure.
- Additional feeding for preferentially fed monitor ewes on Farms 1 & 2 in this trial was via paddock allocation and this cost has not been included. Preferential feeding on Farm 3

occurred through feeding of extra barley which had been grown on the farm; this was considered as an opportunity cost.

- Extra costs of marking additional lambs have not been included in these calculations.
- Infrastructure cost:
    - A quote of $22,000 was obtained from Tru-Test (the brand of product used on the three host sites) for the equipment required to autodraft ewes (XR5000, panel reader, 3 way autodrafter).
    - This infrastructure cost was amortised assuming a 10-year depreciation, and then divided by the number of ewes on each farm, to depreciate per 100 ewes.
- The lamb value in these calculations is based on a 10-year and 5-year average over the hooks (OTH) value, for light lambs (12-18kg CWT), assuming a 45% dressing weight.

4 Results

4.1 Pre-project surveys

A survey was completed by the five original core producers, three of whom went on to complete data collection. Findings included:

- Core producers' level of comfort with using technology associated with eID varied from 50-90 (on a scale of 0-100).
- Two of the producers did not own technology related to data collection with eID.
- Those producers that collected data on individual animals, collected weight/weight gain, and scanning data, but only one producer used the data to make decisions.
- When given set options as to what would make them more likely to record data on individual animals, producers' most common responses were more training, an app, someone to help analyse data or make decisions, and more staff or time.
- When asked how eID-related technology could benefit their farm or enterprise, answers included:
    - Improved data allowing for informed decision making
    - Help determine better performing ewes. Help determine which individuals to cull
    - Being able to know what each sheep's performances are would be very beneficial
    - By selecting for specific traits, identify and cull animals, and increasing labour efficiency in the sheep yards, eg auto drafting.

A survey was also obtained from 9 observer producers. Findings included:

- Most producers condition scored their ewes, most commonly at pre-joining, 'as required'/after shearing/when ewes are in the yards.
- Most producers owned scales and eID-related technology
- Producers' level of comfort with using technology associated with eID varied from 24-97 (on a scale of 0-100).
- Most producers recorded data against individual animals, and used this data, including fleece parameters and condition scores as well as weights, to aid decisions on culling, or for ram selection/ASBVs.
- One respondent stated that they would benefit from 'training in using the Gallagher HR5 eID recorder and data collector as not using it to its full potential'.
- When asked how eID-related technology could benefit their farm or enterprise, these producers answered:

- Genetic progress
- Identify maternal data to improve rating on SGA or to meet our breeding objectives
- Monitoring ewe and sire performance, turning off lambs at the right time
- Stud breeder. Can't live without it.
- Recording weight gains. Identify twins/single
- Measuring ewe weight on a flock basis (to prevent ewes from getting too large) or help with breeding objectives.
- Increase efficiency and productivity. Eid's and data collection are used every day with decisions on farm.

4.2 Producer workshops

An information session/workshop was completed on 1st August 2018 before data collection began, with the purpose of engaging local producers. It was attended by 27 producers, consultants and industry support people. There was discussion of the concept, premise and design of the PDS. Other presenters were Rob Wyld of Sapien Technology; and Scott Davis of Datamars (TruTest).

A second on-farm workshop was then held in March 2019 in response to recognition of producers' desire to learn more about how to get the most out of eiD-related equipment. Twenty two core and observer producers attended this session. The first session of the day was as a core producer focus group, with an update of results. This was followed by a workshop open to all producers, consisting of an update on the PDS. The PDS facilitator, having learned through that Tru-Test equipment was the most widely used by producers in the area, had invited Scott Davis of Datamars (Tru-Test), who presented an interactive workshop on what equipment is available, and how to use key functions of it. Then followed a demonstration involving weighing and entering data on sheep in the yards. Outcomes and discussion points from these days included:

- Data management is not something that producers generally feel confident with
- Being able to hold data and do something with it is what they really want
- There is a need for efficient management of data, and use of technology that already exists
- There are some resources available, but many producers lack the time to fully explore what is available or possible
- The core producers have an interest in objective measurements of the flock and recognise this is a path to improvement however time is a constraint
- Core producers valued the data obtained so far during the PDS, however time to weigh or condition score ewes was a challenge, particularly if this monitoring was done on a large scale

The interim results of the project were also presented at the Sheepvention Innovations Hub in August 2019, and the project and results were well received by attendees.

4.3 Monitoring ewe bodyweight

4.3.1 **Farm 1**

Figure 1 shows the difference in mean bodyweights between the control and monitor ewes during the PDS. The Monitor ewes had a higher scanning percentage than the Controls in Year 1 (175% compared to 165%). Due to logistics, Control and Monitor single and triplet bearing ewes were lambed together. Unfortunately, some of the ewes were inadvertently returned to the wrong treatment group from

weaning onwards, and their results after this were therefore excluded. Ewes lost weight between marking and weaning and gained it again after weaning. The Control ewes had a higher scanning percentage than the Monitors in Year 2 (208% vs 199%). On the occasions when the control ewes were weighed, the largest differences between these and the monitor ewes were seen during pregnancy and at weaning, when ewes were under more nutritional pressure. Monitor ewes were not preferentially fed in summer 2019-20 as all ewes in these mobs were above condition score 3.

Figure 2 shows the difference between the average bodyweight of 'light' and 'heavy' ewes throughout the PDS, before and following preferential feeding. Nearly 10% of the monitor mob, or 18 of 185 ewes, were below Condition Score 3, or more than 3kg lighter than their calculated individual Standard Reference Weight, and so were drafted off as 'light' in January 2019. The light ewes responded well to preferential feeding and were slightly heavier than the 'heavy' ewes on average, until pre-lambing. They then lost more weight than the heavy ewes during lactation, but gained it again after weaning. The preferentially fed ewes had a higher scanning % in both years, though it should be noted that these observations were only on a small number of ewes (of the 18 ewes drafted off in January, there were 13 left at Scanning 2020, most of the rest having been classed out for reasons unrelated to the project).

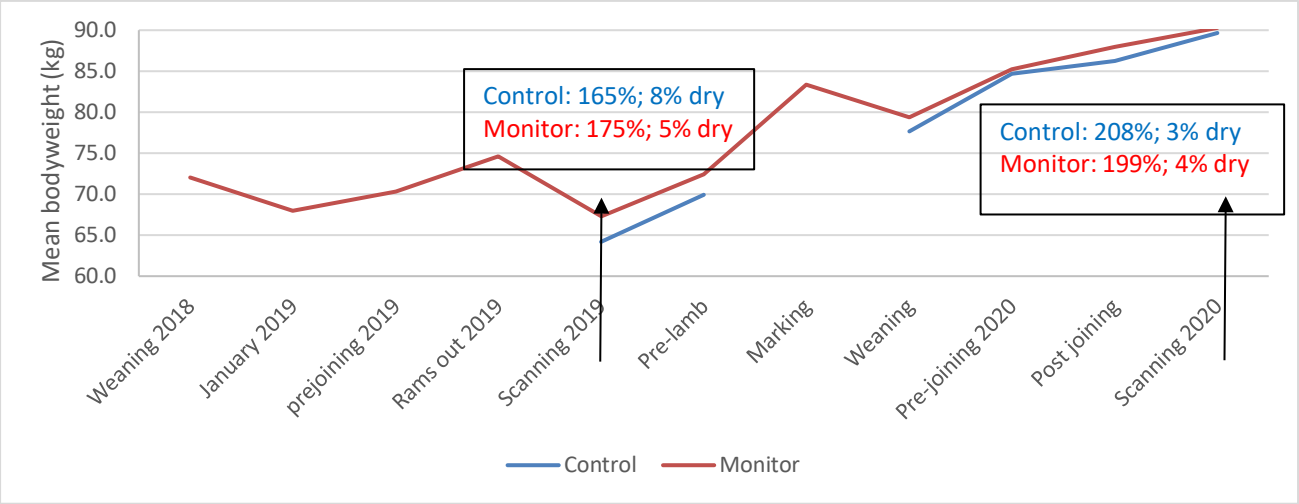


Fig. 1. Mean bodyweights of Monitor and Control ewes on Farm 1.

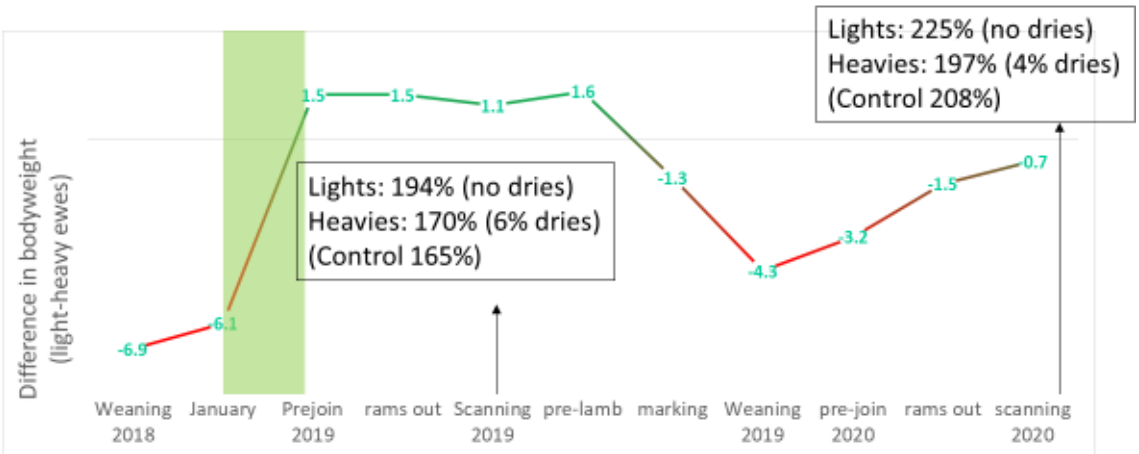


Fig. 2. Difference between average bodyweight of light and heavy ewes (18 light ewes, 167 heavy ewes), and their scanning results. Scanning results of Control ewes are shown for reference. The preferential feeding period is shown by the green shaded area.

4.3.2 **Farm 2:**

On the occasions when they were weighed, the Control ewes had a similar average bodyweight to the Monitor mob (Figure 3), however there were several occasions on which the Control ewes were not weighed, including before joining, and during pregnancy in Year 1. Monitor ewes gained weight before joining but then lost weight during joining; ewes were weighed off shears at scanning and so this bodyweight is misleading. The Monitor mob had a higher scanning % in in Year 1 (120% vs 108%), but a similar scanning % to the Control mob in Year 2 (157% vs 158%). Ewes were not weighed before lambing, but gained weight between Marking and November 2019, before losing it again coming into joining. The good season in 2020 is demonstrated by the average ewe condition scores from Marking through to November 2019, which are much higher than the average on farm.

In January 2019, 14% of ewes in the Monitor mob were below Condition Score 3 and were more than 3kg lighter than their reference weight and were drafted out as 'light'. Fig. 4 shows the difference between the average bodyweight of 'light' (n=21) and 'heavy' (n=130) ewes throughout the PDS, before and following preferential feeding. The light ewes did respond to preferential feeding but still had a lower average bodyweight than the heavy ewes at rams out and scanning. By marking they were 3.6kg lighter, though they gained some weight in relation to the heavy ewes after this point. Though they had a lower scanning % in year 1 (109% vs 124%), they did have a higher scanning % in year 2 (177% vs 156%). As on Farm 1, there was attrition during the course of the trial.

Monitor ewes were not preferentially fed in summer 2019-20 as all ewes in these mobs were above condition score 3. The ewes on which had been preferentially fed the previous summer had higher scanning percentages than the ewes which had not (177% vs 156%), though it should be noted there were only 14 light ewes by left in the flock by this observation.

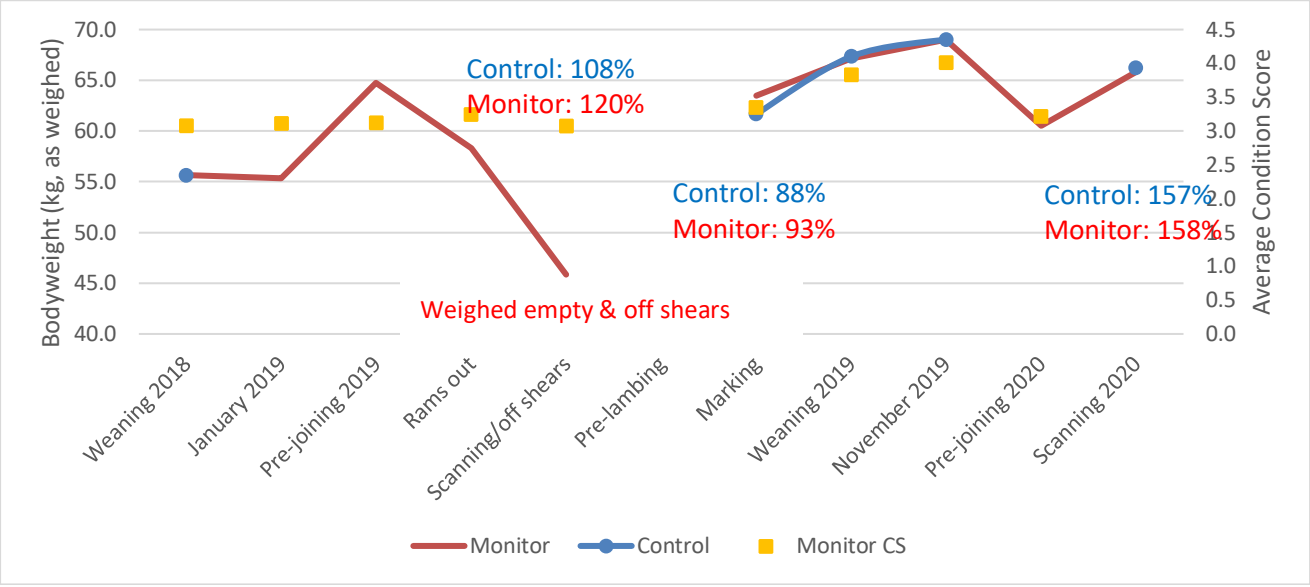


Fig. 3. Average bodyweights of Control (blue line) and Monitor (red line) ewes, Condition score of Monitor ewes (yellow squares), and Scanning and Marking % of both mobs.

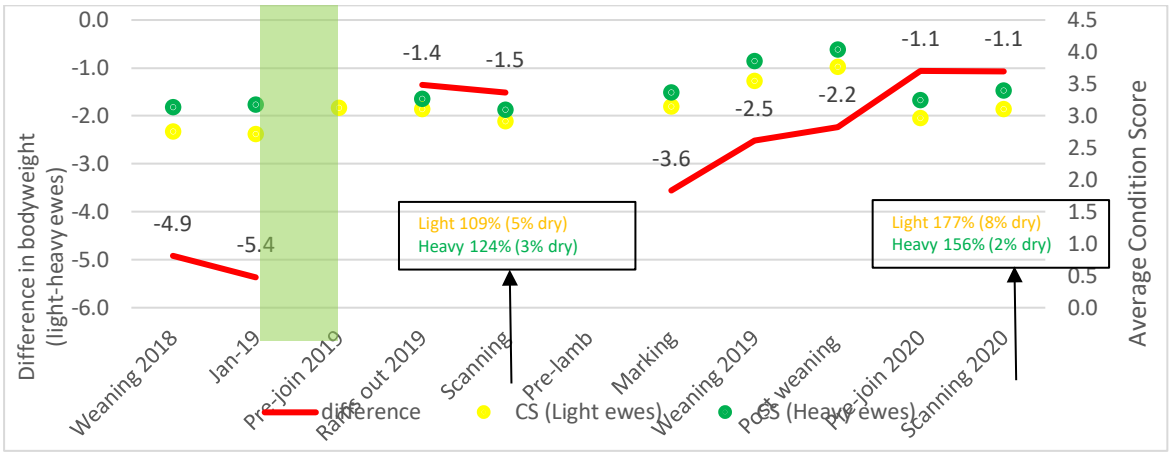


Fig. 4. Difference between average bodyweights of light and heavy ewes in the Monitor mob, average condition score & Scanning %

4.3.3 **Farm 3:**

On Farm 3, the Monitor ewes were heavier than the Control ewes at enrolment, and this was consistent throughout the project. The two mobs followed a fairly similar pattern of weight change. The Monitor ewes had a higher scanning percentage than the Controls in Year 1, but more lambs were lost in the Monitor mob than the Control, between scanning and marking 2019 which was unexpected. The Monitor ewes again had a higher scanning percentage than the Control ewes in 2020.

In January 2020, the producer on Farm 3 drafted off 47 ewes in the monitor mob (38% of the mob) which were below condition score 3, and preferentially fed them for 3 weeks, until joining (with better quality paddock feed as well as 200g more of a bean/barley blend). The use of eID gave the opportunity for the ewes' previous weight and scanning percentage to be examined retrospectively. These light ewes had been a similar weight (and condition score – around 0.2 of a condition score difference) as the heavy ewes until pre-lambing and had a higher scanning % in 2019 (152 vs 130%). They lost weight during lactation and the summer that followed and responded partially to preferential feeding. Despite being nearly 4kg lighter than the heavy ewes at joining, the two groups of ewes had the same Scanning % in 2020. This lends weight to the argument that these ewes which were under CS 3 in January 2020, were the more productive ewes in the mob.

The producer on Farm 3 had also drafted off light ewes at weaning and preferentially fed them for a short time but then these ewes were returned to the rest of the Monitor mob shortly afterwards. These ewes which were light at weaning had also had a higher scanning percentage previously (167% compared to 137%; results not shown in Appendix).

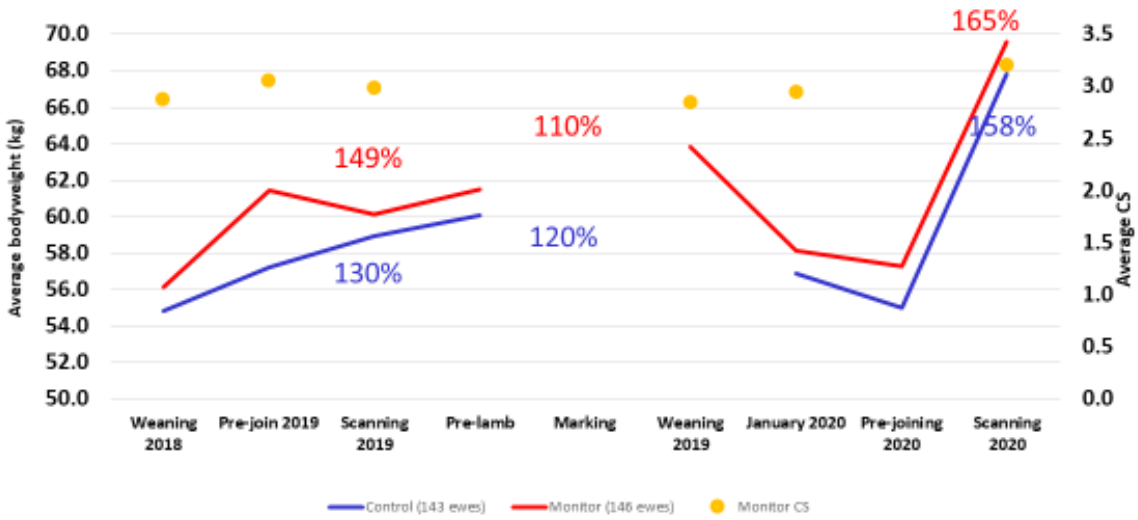


Fig. 5. Average bodyweights of Control and Monitor ewes, average Condition Scores of Monitor ewes, and Scanning and Marking %

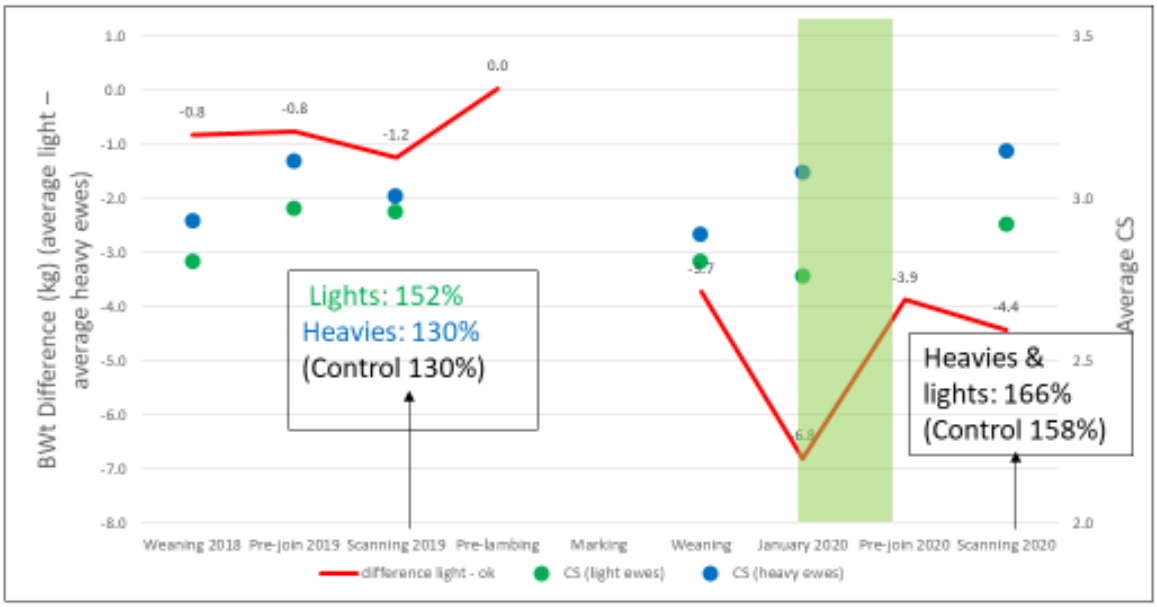


Fig. 6. Difference between the mean bodyweight of light and heavy ewes, and their mean Condition Score, before and after preferential feeding (the timing of which is represented by the green shaded area), and their scanning % in 2019 and 2020.

4.4 Relationship between liveweight and condition score

The prediction of ewes' condition score based on bodyweight at a particular time, was used as a proxy for estimating the accuracy of a calculation of a Standard Reference Weight (SRW) for that ewe. These predictions are shown in Table 3.

Table 3. Percent of Monitor mob with condition score (CS) predicted to within + or – 0.25 or 0.5 of a condition score, based on previous observations

Farm	Kg assigned per CS for small, medium & large frame, respectively	CS predicted based on which previous observation	% of mob predicted to:	
			± 0.25 of a CS	± 0.5 of a CS
1	12, 14 & 16	Jan 2019, based on weaning 2018	67	90
2	7, 8.5 & 10	Jan 2019, based on weaning 2018	83	98
	7, 8.5 & 10	Rams out 2019, based on weaning 2018	42	70
	7, 8.5 & 10	Wean 2019, based on wean 2018	20	39
	10, 12 & 14	Wean 2019, based on wean 2018	48	72
	10, 12 & 14	November 2019, based on wean 2019	67	93
	10, 12 & 14	Pre-join 2020 based on Nov 2019	65	88
	10, 12 & 14	Pre-join 2020 based on wean 2019	27	69
3	9, 12 & 15	Pre-join 2019, based on wean 2018	54	76
	12, 15 & 18	Pre-join 2019, based on wean 2018	63	80
	12, 15 & 18	Wean 2019, based on wean 2018	43	74
	12, 15 & 18	January 2020, based on wean 2019	75	93

4.5 Lamb production

Overall, there was no difference observed between the Monitor and Control mobs, however this is partly because of on-farm factors, namely:

- On Farm 1, Monitor and Control single- and triplet-bearing ewes were run together during lambing, for logistical reasons. Therefore, the weights and numbers of monitor vs control single and triplet lambs are unknown and cannot be compared. Results of twin lambs were unremarkable.
- On Farm 2, some of the lambs were crossbreds due to misjoining (10% of the control lambs, and 17% of the monitor lambs) so average bodyweights of all lambs in the two treatment groups could not be compared because of differences in the weights of each breed. When both Merino and crossbred lambs were taken into account, the monitor ewes had a slightly higher marking percentage (101% compared to 98%).

- On Farm 3, a sample (around half) of the control and monitor lambs were weighed at marking, to get an average weight. The monitor lambs were heavier on average at marking (21.5kg vs 19.8kg) and weaning (29.5kg vs 28kg), compared to the controls. However, the weaning percentage in the control lambs was higher than that of the monitor lambs due to the loss of a larger than expected number of lambs in the monitor mob between scanning and marking/weaning, and there is therefore a higher kg lamb weaned per ewe in the control mob.

These circumstances illustrate that this is still an important limitation for the application of eID in commercial enterprises. Because of the circumstances above, these results should be interpreted with caution. Matching lambs to ewes more accurately is an important future area of work for eID, as it is important for overall, accurate monitoring of ewe reproductive performance.

4.6 Partial budget

4.6.1 Farm 1:

The usual practice on this farm is to weigh all ewes, but only the time taken to weigh monitor ewes was used in calculations, as no interventions were made in the control mob. The time used in the calculations in Table 4 was up to and including ram removal, but not scanning, in 2019, because scanning results are used for calculations of benefits.

The single and triplet control and monitor ewes lambed together for logistical reasons, so it is not possible to compare the total marking or weaning percentages of the control and monitor mobs. Therefore, for this analysis, the lamb survival was calculated by comparing the overall number of lambs scanned (710) to number of lambs weaned (617): a survival of 87%. The lamb weaning weight used in the calculations is the average weight of all lambs on this farm, including singles, twins and triplets, (weighed after yarding overnight). At the commencement of the trial, there were 2,200 ewes on the farm; therefore, the cost of depreciation of equipment is $100 per 100 ewes.

Using these calculations there was a 4.3-4.7 times return on investment for weighing these ewes up until scanning, using 10-year average and 5-year average lamb prices. This is a significant return on investment for the time taken and demonstrates that regular weighing of ewes can be of benefit in a commercial sheep enterprise. If time spent weighing up until pre-lambing is taken into account, a 4-times return on investment was obtained.

In 2020, no preferential feeding occurred as the ewes were all above condition score 3. The Control ewes had a higher scanning result than the Monitor ewes, perhaps owing to the excellent season, when ample green feed was available at joining, giving a negative return on investment.

Table 4a. Labour and inputs and costs, depreciation of equipment, and number of lambs scanned in control and monitor ewes, and calculated extra number of lambs weaned from monitor ewes.

Group	No. ewes at trial start	Time weighing (hours)	Labour cost /hour	Total labour cost ($)	Labour Cost / 100 ewes ($)	Labour + depreciation /100 ewes ($)
Control	212					
Monitor	211	4	30	120	56.87	156.87

Table 5b. Number of lambs scanned in control and monitor ewes; and calculated extra number of lambs weaned from monitor ewes.

Group	No. lambs scanned	Scan %[A]	Extra lambs / 100 ewes	Lamb survival scan to wean (%)	Extra lambs weaned / 100 ewes
Control	345	163		87	
Monitor	365	173	9.5	87	8.2

[A]Scanning % is no. lambs scanned/no. ewes at trial start

Table 6a. Weaning weights and value of lambs using 5-year average prices

	Weaning liveweight (kg)	Lamb price (c/kg CWT)[A]	Income per lamb ($)	Extra income for additional 8.2 lambs weaned ($)	Return on investment per 100 ewes[B] (%)
Control	32.0	622	89.57		
Monitor	32.0	622	89.57	738.62	471

[A]Lamb price based on a 5-year average over the hooks (OTH) value, for light lambs (12-18kg CWT), assuming 45% dressing out; [B]Return on investment calculated by dividing additional income received by labour & depreciation cost

Table 7b. Weaning weights and value of lambs using 10-year average prices

	Weaning liveweight (kg)	Lamb price (c/kg CWT)[A]	Income per lamb ($)	Extra income for additional 8.2 lambs weaned ($)	Return on investment per 100 ewes[B] (%)
Control	32.0	575	82.80		
Monitor	32.0	575	82.80	682.81	435

[A]Lamb price based on a 10-year average over the hooks (OTH) value, for light lambs (12-18kg CWT), assuming 45% dressing out; [B]Return on investment calculated by dividing additional income received by labour & depreciation cost

4.6.2 **Farm 2**

An additional labour unit was required Farm 2, due to yard set up and recording of individual ewe condition scores (which did not occur on Farm 1). With this extra labour cost, as well as the depreciation of equipment ($26.82 per 100 ewes, over the 8,200 ewes on the farm), the Return on Investment in 2019 was around 2.5 times, for both 5- and 10-year average prices. In 2020, the Monitor ewes had a similar scanning result to the Controls, and so there would have been a negative Return on Investment.

Table 8a. Labour and inputs and costs, depreciation of equipment, and number of lambs scanned in control and monitor ewes, and calculated extra number of lambs weaned from monitor ewes

	No. ewes at trial start	Time spent weighing up to and including marking (hours)	Labour cost / hour	No. labour units	Total labour cost	Labour / 100 ewes ($)	Labour + depreciation cost/100 ewes ($)
Control	159						
Monitor	161	3.25	30	2	195	121.12	147.95

Table 9b. Number of lambs scanned in control and monitor ewes, and calculated extra number of lambs weaned from monitor ewes

	Scan%[A]	Extra lambs per 100 ewes	Mark %	Extra lambs / 100 ewes
Control	108		88	
Monitor	120	12	93	5

[A]Scanning % is no. lambs scanned/no. ewes at trial start

Table 10a. Weaning weights and value of lambs using 5-year average prices

	Weaning wt (kg)	Lamb price (c/kg CWT)[A]	Income per lamb ($)	Extra income for additional 5 lambs weaned	Return on investment per 100 ewes[B]
Control	27.8	622	77.81		
Monitor	28.0	622	78.37	$391.86	265%

[A]Lamb price based on a 5-year average over the hooks (OTH) value, for light lambs (12-18kg CWT), assuming 45% dressing out; [B]Return on investment calculated by dividing additional income received by labour & depreciation cost

Table 11b. Weaning weights and value of lambs using 10-year average prices

	Weaning wt (kg)	Lamb price (c/kg CWT)[A]	Income per lamb ($)	Extra income for additional 5 lambs weaned ($)	Return on investment per 100 ewes[B]
Control	27.8	575.0	71.93		
Monitor	28.0	575.0	72.45	362.25	245%

[A]Lamb price based on a 5-year average over the hooks (OTH) value, for light lambs (12-18kg CWT), assuming 45% dressing out; [B]Return on investment calculated by dividing additional income received by labour & depreciation cost

4.6.3 **Farm 3**

The return on Investment on this farm was negative in 2019, due to the loss of an unexpected number of lambs in the monitor mob compared to the controls, between scanning and marking. The Return on Investment for 2020 was calculated and details are below; this figure is around 5 times ROI based on scanning results at the end of the project.

Table 12a. Labour and inputs and costs and depreciation of equipment

	No. ewes in Jan	Time spent weighing[A] (hours)	Labour cost per hour ($)	Total labour cost ($)	Labour Cost per 100 ewes ($)	Labour + depreciation cost / 100 ewes ($)
Control	119					
Monitor	133	1.33	30	39.96	30.05	103.38

[A]In January & February (i.e. to draft ewes off & then weigh again at joining)

Table 13b. Number of lambs scanned in Control and Monitor ewes

	No. ewes in Jan	No. lambs scanned	Scan %	Extra lambs per 100 ewes
Control	119	188	158%	
Monitor	133	220	165%	7

Table 14a. Expected weaning weights and value of lambs using 5-year average prices

	Expected Weaning weight (kg)	Lamb price (c/kg CWT)[A]	Income per lamb ($)	Extra income for additional 7 lambs weaned ($)	Return on investment per 100 ewes[C] (%)
Control	28.0	622	78.37		
Monitor	28.0	622	78.37	548.60	530

[A]Estimated weaning weight (2019 weaning weight). Assuming that survival will be the same in both control & monitor mobs; therefore, there will still be an additional 7 lambs weaned per 100 ewes in the monitor mob compared to the controls; [B]Lamb price based on a 5-year average over the hooks (OTH) value, for light lambs (12-18kg CWT), assuming 45% dressing out; [C]Return on investment calculated by dividing additional income received by labour & depreciation cost

Table 15b. Expected weaning weights, and value of lambs using 10-year average prices

	Weaning weight[A]	Lamb price (c/kg CWT)	Income per lamb ($)	Extra income for additional 7 lambs weaned ($)	Return on investment per 100 ewes[C] (%)
Control	28.0	575.0	71.45		
Monitor	28.0	575.0	72.45	507.15	490

[A]Estimated weaning weight (2019 weaning weight). Assuming that survival will be the same in both control & monitor mobs; therefore, there will still be an additional 7 lambs weaned per 100 ewes in the monitor mob compared to the controls; [B]Lamb price based on a 10-year average over the hooks (OTH) value, for light lambs

(12-18kg CWT), assuming 45% dressing out; [C]Return on investment calculated by dividing additional income received by labour & depreciation cost

4.7 Post-project communications

A Zoom meeting was held with the core producers in early August 2020, at which results were presented and a discussion followed. Producers indicated that they felt they benefited from knowing the effects of changes in management more precisely (e.g. 'proof of concept' of the effect of preferential feeding of light ewes), making them more confident to make such management changes across their whole flock. Another point of discussion was that another use of eID is the recording of parameters other than weight (e.g. whether or not a ewe had a low condition score). One of the farms is considering investing in a 'bulk reader' to record eIDs of these ewes as they leave the drafting race. This is quicker than weighing ewes or putting them through the autodrafter, which can be slow with a large number of ewes (Farm 2 currently runs 8,500 ewes plus lamb and hogget replacements).

Due to COVID-19 restrictions, a webinar was held in lieu of a field day on October 7 2020, in conjunction with Agriculture Victoria and Elise Bowen, of Sheep Data Management. This webinar ran for nearly 2 hours and had over 30 attendees. A summary of the overall results and findings were presented, followed by a 'Producer Discussion Panel', attended by two of the three core producers. This webinar is available at https://www.dropbox.com/s/4k8791tg8vlzw3x/EID%20enabled%20ewes%20webinar%20201007.mp4?dl=0.

4.8 Survey of producer attitudes and confidence to using eID

Producers were asked four questions after they had completed each monitoring event, relating to logistical and technological components of the exercise. The questions and summary of answers to each are available in the Appendix. Briefly, producers generally found that the technology (reader, scales, autodrafter) worked very well together, and that they could refine the process of data collection during the project, including use of the XR functions to get information on the ewes in 'real time'. There were positive comments on preferential feeding.

Lack of time, and logistical difficulties were challenges mentioned by all producers. One way that the producers suggested to overcome this was to plan events ahead of time and prepare where possible (e.g. change XR settings the evening before). When asked whether they would do anything differently next time, one producer said he would condition score ewes earlier so that preferential feeding could be more effective.

Core producers also completed an exit survey following the final presentation of results; the summary is in the appendix, but brief results include:

- 2 out of 3 core producers had an increase in their 'level of comfort' with technology; the two farms that did not use data to make decisions before the project, were doing so at the completion of the project.
- All 3 producers said that the PDS increased their knowledge of the liveweight ranges of their ewes and what it means to their farm; how their ewes might respond to preferential feeding, and functions of their eID recording device (responses were 8-10 on a scale of 1-10; 10 being a large increase)

- 'Take-home' messages included that that condition scoring is important; and that weighing and preferentially feeding can lead to better ewe production.

5 Discussion

5.1 Project delivery as it relates to the objectives

1. At least 20 core and observer producers will gain an understanding of, and confidence with, eID-related technology after attending a workshop; the core producers will consolidate these skills by repeating them at subsequent husbandry events.
   - 20-30 producers attended the workshops held in August 2018 and March 2019. The events were well attended and received good feedback. Engagement by core and observer producers with the project and with eID-related technology was very positive.
   - The details and trial design of the PDS were also discussed at both workshops, and gained good engagement from producers. Good verbal feedback was received from a number of producers and consultants.
   - Core producers successfully consolidated the skills associated with using this technology, as evidenced by their responses to the exit survey

2. The bodyweight of ewes on at least 5 farms will be monitored for one year, and technology associated with eID will enable producers to: Identify and appropriately manage any low bodyweight ewes or those losing weight; find differences in production of ewes and mortality of ewes and lambs between monitored and control mobs; demonstrate a relationship between bodyweight & subsequent reproductive performance; analyse lamb production of monitored and control ewes, and conduct a cost benefit analysis of purchasing eID-related software/hardware and monitoring ewes:
   - Ewes were monitored for eighteen months (1.5 production cycles) on three farms, as the other two farms were unable to monitor ewes. The three farms did identify and manage low bodyweight ewes, and differences in production, though not always number of ewes retained, were observed. This was in part due to the nature of the study, where ewes were sometimes lost to follow up for reasons other than death. Crucially, a relationship between bodyweight, and weight change, was observed by following the preferentially fed ewes, and lamb production was analysed as much as was possible. A partial budget of eiD related software and hardware was conducted.

3. A field day attended by at least 30 producers will be conducted, and regular written and verbal communications will be produced to give updates on trial results
   - Interim results were presented in the Innovations Hub at Sheepvention in 2019
   - Core producers were engaged in regular written and verbal communication. Final results were formally presented to core producers in early August 2020.
   - In addition to the field day held in March 2019, a webinar was held in October 2020 in place of a field day, due to COVID-19 restrictions. This webinar was facilitated by Agriculture Victoria, had over 50 registrants and the live event was attended by over 30 individuals.
4. Demonstrate that at least 70% of core and observer producers are more confident in the use of eID-related technology, as shown by an exit survey.
   - In response to the question "on a scale of 1-10, what is your level of comfort with 'technology'", two of the three core producers recorded a higher score after the survey than before (i.e. more comfortable)
   - In response to the question "on a scale of 1-10 *(*1 being no increase, 10 being a large increase), has this PDS increased your knowledge of the functions that your recording device (e.g. XR or

similar) is capable of, i.e. what it can theoretically do?", one producer answered 7, the others 9 out of 10, showing the PDS was very successful in this regard.
- The Best Wool Best Lamb groups that made up the observer producers was unfortunately discontinued during the course of this project.

From these objectives, there are two main areas which will be discussed here in more detail.

5.1.1 Producers' confidence with eID and consolidation of skills, and practical implementation on farms (Objectives 1 & 4)

Of the five farms originally enrolled in this project, two were not able to complete the observations, and this is an important outcome to note. The reasons for this included change in decisions around management of ewes and of the farm in general, and unavailability of required equipment. These are realities in commercial sheep enterprises, and are some of the challenges involved with the use of eID becoming more widespread. One of the successes of this PDS was that producer confidence in the use of eiD increased during the project, as evidenced by the responses to the exit survey. However, there remain barriers to its broader implementation on farms. For example, one comment from producers was that the time involved in weighing and condition scoring was a barrier to adoption, particularly at busy times of year if other enterprises are run on the farm; namely, Farms 2 and 3 had significant cropping enterprises, and Farm 2 has a large number of ewes, making time a scarce commodity; sometimes the monitoring of ewes did not occur, as seen by the gaps in the results. This is an important finding and makes it particularly important to be able to demonstrate a tangible benefit of monitoring ewes, and to make the decision-making process following data collection as quick and easy as possible for producers.

Furthermore, and in support of this, another observation is that there may be a delay between collecting data and sending it away for analysis, and producers may not be in a position to analyse or interpret the data collected. Therefore, for eiD to be used to its full potential in a commercial flock, and for the time taken to collect data to generate a positive return on investment, there should be decision support tools available. Whether or not producers would be willing to pay for these on a fee-for-service basis is another matter.

Whilst close monitoring of ewes may not be necessary or cost-effective in every year or season, some functions of data recording devices (such as the XR5000) have the potential to be extremely useful to producers, but may not be known about; or producers may be unfamiliar with the technology, as evidenced by the pre-project survey, which albeit was a small, convenience sample. There is a need for this information to be presented to producers, or better publicized or made available by the manufacturers. This was raised by Pattinson (2013); this PDS has shown that this need still exists. Another area which warrants investigation is the long-term practices of the core producers, and whether they continue to record data against individual ewes and then, critically, make use of this information without facilitation.

5.1.2 Using ewe bodyweight to identify poor performing ewes, and relate ewe performance to bodyweight (Objective 2)

The results with regards to preferential feeding on Farm 3 indicate that these light ewes were more productive and may well have reared more kg of lamb per ewe than the heavy ewes – this is supported

by their higher scanning % and weight loss during lactation, though unfortunately lambs were not able to be individually identified to ewes during the trial. Furthermore, these ewes had the same overall scanning percentage as the heavy ewes, though they were lighter at joining. Whether this is because these ewes are more fertile, or just because of the effect of feeding prior to joining, is unknown. Regardless, producers indicated that they felt they benefited from knowing the effects of changes in management more precisely.

One of the potential tools of 'precision management' of ewes which requires further research is the calculation of an individual standard reference weight for each ewe. This PDS showed that this is possible, though variably accurate. All these observations were whilst the ewe was not pregnant, and foetal and fluid weight would add an extra level of complexity to these calculations.

This variability in accuracy (Table 3) demonstrates the complexity of the relationship between bodyweight and condition score; but potential exists to increase the accuracy of this calculation. Frame size appears to be a key determinant of the accuracy. This is an exciting space for the industry, because of the potential to automatically identify ewes in poor condition or which have lost weight, despite the variation in bodyweight even within flocks and age groups due to frame size.

5.2 Insights relative to previous research

'Precision sheep management' has been the subject of discussion in the sheep industry for some time now. Rowe and Atkins (2006) stated that "managing individual animals rather than flocks will lead to greater increases in productivity and profitability for the Australian sheep industry" (Atkins and Richards 2007). This management style moves away from the 'mob-based management' traditionally practiced in commercial sheep enterprises, and the process of management of individual data is facilitated by electronic ID. What remains now is to 'bridge the gap' between what is theoretically possible with the use of eID, and what is reasonably achievable in a large scale sheep enterprise, with large numbers of sheep and limitations on time; furthermore, the gap between the collection of data, and its practical utilisation, must be bridged if eID is to be successful in commercial sheep enterprises.

Some of the limitations to adoption mentioned by Pattinson (2013) included the need for training or skills development in this area, the complexity and difficulties with the interface of the components involved, for example technology and hardware; and the requirement for IT capability. This PDS found that these limitations are still valid. One of the extension priorities identified by Pattinson was the development of training courses for producers, as well as service providers; another was the development of demonstration farms "to highlight the use and benefits of the technology". This PDS enabled the use of eID to be demonstrated in commercial sheep enterprises, including the barriers to its adoption.

Numerous case studies on producers using electronic ID have been published, including Sheep CRC – Precision Pays. These case studies show that eID can be used in a wide range of sheep enterprises to record a range of data, including bodyweight in the yards or via Walk Over Weighing, fleece parameters, or pregnancy status. Obtaining an individual reference weight for each ewe, as was attempted at the beginning of this PDS, is the natural progression of this data collection and utilisation.

The results of the cost benefit analyses in this PDS varied, ranging from between a negative return on investment, to between 2.5 x, to 5.3 times return on investment, within a season. In this PDS, a positive

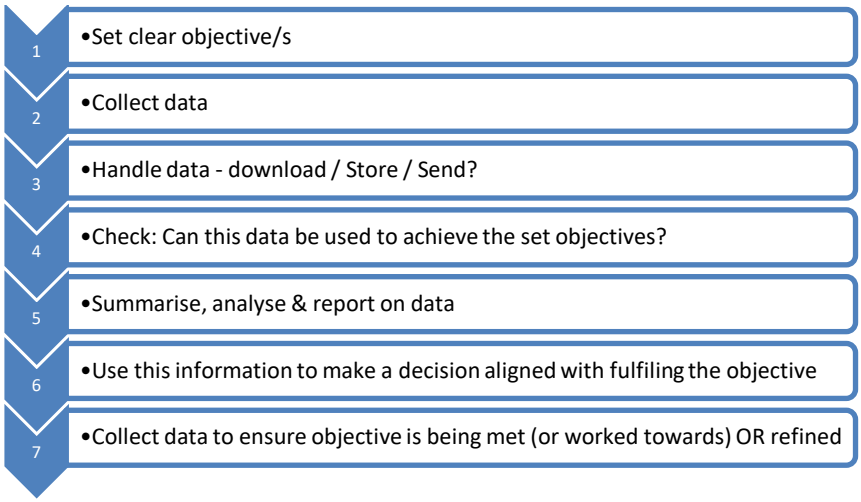
Return on Investment for monitoring ewes tended to occur when ewes were under nutritional pressure and when on-farm logistics, such as paddock allocation, could be well implemented. Benefits were less likely to be demonstrated when time was limited, ewes were under less nutritional pressure and/or it was not possible to implement management changes due to paddock or yard logistics. This is the crux of the application of electronic ID on farms – commercial sheep enterprises are, by their very nature, complex, with many factors contributing to outcomes and events.

The average return on investment obtained by Dickson (2019) in his modelling study, using different selection criteria to this project, was $4.12 return for every dollar invested, over 5 years. However, these two studies demonstrate that there is potential benefit within a season, as well as over successive years. Another modelling study conducted by Atkins and Richards (2007, unpublished) showed that precision sheep management gave a 28%, 24% and 16% increase in profit in fine wool, medium wool and dual purpose (broad wool) flocks, respectively. Again, whilst very encouraging, these benefits are over ten years, and by the nature of the study, do not take into account the complexities of implementation or utilisation in a commercial system.

The variability of the results in terms of bodyweight, scanning or marking percentage, and cost benefit in this PDS, support Dickson's statement that eID in itself does not increase profitability, it is how it is used on farms that does so; i.e. electronic ID enables the collection of data that has the potential to increase profitability but is not able to be gathered, or is too time consuming to be gathered, without electronic ID; but the data must be put to use, and be able to be implemented, to increase profitability.

5.3 Implications for industry and additional research

The ease of collection of data using eID means that there is a risk of collecting data without a real purpose behind it or without then using it; therefore, to be of value, data collection must be undertaken in a targeted fashion, with purpose. From observations and producer discussions throughout the PDS, we suggest the following steps are required to achieve a useful implementation of eID in commercial enterprises:



This PDS attempted to address Steps 2 (making collection of data easier and practical in commercial sheep enterprises), 4 (whether collected data can achieve the objective of increasing ewe performance, and how it can be done), and 6 (actually using the data to move towards the objective).

However, we suggest that further research into the technical and implementation aspects of using eID is required to fulfil this pathway more effectively.

5.4 Extension messages

The extension messages from this project include:

- eID is helpful to facilitate management and preferential feeding of light ewes
- It can demonstrate a 'proof of concept' for a management practice such as preferentially feeding light ewes, giving producers more confidence around implementing these strategies on a larger number of ewes
- eID can be used to record data (such as light/heavy status, and scanning result) which can be easily used to make management decisions in the future, without the need for further analysis
- Some resources are available on how to best utilise functions of eID-related equipment; existing resources should be more widely promoted, and more produced
- Automating condition scoring through the bodyweight of ewes may be possible but more work is required in this area

5.5 Project delivery

More information sessions during this PDS, following the first one, would have been beneficial to producers who had more questions after learning about some of the features of the products that enable the use of eiD (for example the XR5000 and stick reader, which were used by the producers in this project); further discussions between the core producers and the observer producers would have been beneficial. The disbanding of the local discussion groups, followed by COVID-19, meant that hands-on demonstration to a group of producers was only possible earlier on in the PDS.

The process of configuration of the XR to draft ewes that were below their calculated Standard Reference Weight off from the main monitor mob, could have been made easier, and practiced more, as it was a reasonably complicated process. There is an opportunity here for more training activities for producers. Furthermore, the excellent season in late 2019 - early 2020 meant that this method was not able to be extensively tested and refined.

6 Conclusions/recommendations

This project has demonstrated a need to provide further information to producers on:

1. How eID can be used on farms as it directly relates to their objective/s, i.e.
    - What data should be collected
    - Why it should be collected, and
    - How this be done as easily as possible
2. The next step: making purchases:
    - What equipment may be helpful to achieve the objectives producers have set, including 'really should have' vs 'nice to have' equipment or features, and readily available producer reviews of available equipment (what has worked well for others, what has not) – this is critical as there appears to be a lack of knowledge of what is available and the relative pros and cons of different equipment

- Cost of equipment and where it can be purchased

3. The 'nuts and bolts' use of eID technology – i.e. how the equipment is actually used
    - Core and observer producer experiences during this PDS indicate that there is a need for workshops or other resources to enable producers to feel confident using technology, increase their knowledge of its capabilities with reference to their own enterprise, and become familiar with its use – i.e. "what can this do, and how do I actually make it do this?" This could occur through workshops, increased after-sales support either in person, online or over the phone, or via resources including videos and fact sheets.
    - Information sessions (in person or webinars) on how to go about using eID, including setting objectives and deciding which data needs to be collected.
4. Calculation of a Standard Reference Weight (SRW) for individual ewes:
    - This would allow management of ewes to become more automated, but to our knowledge, current methods for determining an SRW are either not sufficiently accurate, or not sufficiently evaluated.
    - This project has shown that the calculation of a standard reference weight for ewes could be possible, but would require further calculation, measurement and validation on a large number of ewes. This may be a potential on-farm research project in the future.
5. Use of eID to support decisions
    - A gap still exists between collection of data, and utilisation of this data in a practical and cost effective way by producers, to support their management of ewes – there needs to be an interface between data and its implementation, either via a decision support tool or access to someone to convert the data analysis into management advice or decisions.
6. Further education of the importance of continuing to condition score ewes
    - The importance of managing ewes based on condition score was a large outcome of this project, as evidenced by the differences observed in scanning percentage after management of ewe condition by preferential feeding. This is particularly important because this project has shown that bodyweight is very variable in a flock; therefore, until the calculation of a SRW for individual ewes is achieved, condition scoring remains an important tool for producers.

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1 Appendix

1.1 Results

1.1.1 Pre-project surveys

A survey was completed by the 5 original core producers, three of whom went on to complete data collection. Findings included:

- 4 out of 5 core producers condition scored their ewes; at least at pre-joining and pre-lambing, with some producers condition scoring at least some ewes in the mob whenever they were yarded (or intending to, time permitting)
- Core producers' level of comfort with using technology associated with eID varied from 50-90 (on a scale of 0-100).
- All core producers owned scales and had weighed sheep, though 2 out of 5 did not own technology related to data collection with eID (e.g. monitors, readers). Hence, these 2 farms did not collect data on individual animals. On those farms that did collect data on individual animals, weight/weight gain, and scanning data were collected. Producers on only one of these farms used this data to make decisions on their farm.
- When asked whether they would be more likely to record data on individual animals if they were provided with the following, these were their answers:

Training	An app	Someone to analyse data/help make decisions?	More staff/time	Evidence it's profitable	Other
Y	Y	Y	Y	Y	X
Y	X	X	Y	X	X
Y	Y	X	X	X	X
Y	Y	Y	X	X	X

- When asked how eID-related technology could benefit their farm or enterprise, the core producers answered:
    - Improved data allowing for informed decision making
    - Help determine better performing ewes. Help determine which individuals to cull
    - Being able to know what each sheep's performances are would be very beneficial
    - By selecting for specific traits, eg growth rates, fertility, lamb survival/mothering. Identify and cull animals that are creating issues, eg cast sheep. Increase our labour efficiency in the sheep yards, eg auto drafting.

A survey was also obtained from 9 observer producers. Findings included:

- All 8 of the producers who answered the question said that they condition scored their ewes. The most common times were at pre-joining and other or as required/after shearing/when ewes are in the yards.
- 7 of the 8 producers who answered the question owned scales, and 7 out of 8 owned eID-related technology. Producers' level of comfort with using technology associated with eID varied from 24-97 (on a scale of 0-100).

- 8 of the producers recorded data against individual animals, and also generally used this data; data collected included fleece parameters and condition scores as well as weights, and producers used this data to aid decisions on culling, or for ram selection/ASBVs.
- When asked how eID-related technology could benefit their farm or enterprise, these producers answered:
    - Genetic progress
    - Identify maternal data to improve rating on SGA- other than that we will continue to use the data we collect to meet our breeding objectives
    - Monitoring ewe performance, monitoring sire performance, turning off lambs at the right time
    - Stud breeder. Can't live without it.
    - Recording weight gains. Identify twins/single
    - By weighing the ewes we have discovered that some of our ewes are bigger than we would like. Plus to help with our breeding objectives.
    - Increase efficiency and productivity. Eid's and data collection are used every day with decisions on farm.
- One respondent stated that they would benefit from 'training in using the Gallagher HR5 eid recorder and data collector as not using it to its full potential'.

1.1.2 **Producer workshops**

An information session/workshop was completed on 1st August 2018, before data collection began. The purpose of this session was to engage local producers with the project, and was attended by 27 producers, consultants and industry support people. There was discussion of the concept, premise and design of the PDS. Other presenters were Rob Wyld of Sapien Technology, who spoke on how to decide what data to collect in a commercial enterprise; and Scott Davis of Tru Test, who conducted a practical session on how to go about making Tru-Test hardware work for producers.

A second on-farm workshop was then held in March 2019 in response to recognition of producers' knowledge & skills gap in how to get the most out of eiD-related equipment (Tru-Test being the most common type used by producers in the local area). Twenty two core and observer producers attended this session. The first session of the day was as a core producer focus group, with an update of results. This was followed by a workshop open to all producers, consisting of:

- A powerpoint presentation, including an update on the PDS
- A presentation by Scott Davis of Datamars (Tru-Test), covering
    - What equipment is available and the differences between different types of equipment in terms of functions
    - Key functions of e.g. the XR5000 and how to use them
- A demonstration involving weighing and entering data on sheep in the yards

Outcomes and discussion points included:

- Data management is not something that producers generally feel confident with
- Being able to hold data and do something with it is what they really want
- There is a need for efficient management of data, and use of technology that already exists
- It's all pretty new and there are some resources available but many producers lack the time to fully explore what is available or possible
- The core producers have an interest in objective measurements of the flock and recognise this is a path to improvement however time is a constraint

- Core producers valued the data obtained so far during the PDS, however time to weigh or condition score ewes was a challenge, particularly if this monitoring was done on a large scale
- One of the observer producers who attended the second workshop commented that following the workshop, they were able to record ewes' scanning results on their own farm.

1.2 Lamb production

1.2.1 Farm 1

Monitor and control twin-bearing ewes were run separately, and lambs were all weighed after being yarded overnight. The weaning % and kg of lamb weaned per ewe were very similar in the monitor and control twin-bearing ewes.

Table 1. For twin lambs on Farm 1: number, weaning weights, and kg lamb weaned per ewe on Farm 1

Dam group	No. lambs	Average lamb BWt	total kg lamb weaned	no ewes in gp @ pre-lambing	Weaning %	kg lamb weaned/ewe
Control	223	30.5	6805	123	181%	55.3
Monitor	256	31	7947.5	143	179%	55.6

1.2.2 Farm 2:

Lamb results were fairly unremarkable. Some of the lambs were crossbreds due to misjoining (10% of the control lambs, and 17% of the monitor lambs) so average bodyweights of all lambs in the two treatment groups could not be compared because of differences in the weights of each breed. When both Merino and crossbred lambs were taken into account, the monitor ewes had a slightly higher marking percentage .

Table 2. No. control and monitor ewes at marking, count of lambs in each mob, and marking % from these figures

Dam group	No. ewes at enrolment	No. ewes at marking	No. lambs	% marked (no. ewes enrolled)	% marked (no. ewes at marking)
Control	159	143	140	88%	98%
Monitor	161	147	149	93%	101%

Taking into account the Merino lambs only, as these made up the majority of the lambs (90% of control, and 83% of monitor lambs), the control lambs were slightly heavier, but this was not significant.

Table 3. Average marking and weaning weights, and Average Daily Gain of Merino lambs in control and monitor mobs

Dam group	Average marking wt	Average weaning wt	Average daily gain (g/day)
Control	14.5	27.1	236

Monitor	14.3	26.4	231

The average daily gain in the Merino monitor lambs was slightly less than the Merino controls, but this was not significant. The results are similar for the Crossbred lambs. The number of kilograms lamb weaned per ewe has not been compared because of the different proportion of Merino and Crossbred lambs in the control and monitor mobs.

1.2.3 **Farm 3:**

Half of the control and monitor lambs were weighed at marking, to get an average weight. The monitor lambs were heavier on average at marking and weaning, compared to the controls. However, the weaning percentage in the control lambs was higher than that of the monitor lambs, and there is a higher kg lamb weaned per ewe in the control mob.

Table 4. Average marking and weaning weights of lambs of control and monitor ewes, no. lambs at weaning, and sum of weaning weights (total weight of all lambs weaned).

Dam group	Marking wt (kg)	No. at wean	Weaning wt (kg)	Sum of weaning wt	No ewes at pre-lambing	Weaning %	kg lamb weaned per ewe
Control	19.8	161	28.0	4510.5	136	118%	33.2
Monitor	21.5	143	29.5	4224.5	140	102%	30.2

1.3 Survey of producer attitudes and confidence to using eID

Producers were asked four questions after they had completed each monitoring event, relating to logistical and technological components of the exercise. The questions and summary of answers to each were:

1. What worked well?
    - Producers generally found that the technology (reader, scales, autodrafter) works very well together.
    - The multiple datapoints collected by all producers mean that they refined the process of data collection so that it worked very well in their yards.
    - One producer used the 'previous liveweight' function on the XR which enabled him to compare the weight change of the preferentially fed ewes to that of the main mob, directly and immediately, 'weigh-crate-side'. This enabled him to see that the preferentially fed ewes gain weighed as desired but the rest of the mob had lost weight, which was undesirable. This enabled him to change his management after this weighing event (increase feed quality/quantity) and also gives him information as to how to change his management of ewes during summer next year.
    - One producer commented that separating and preferentially feeding light ewes worked well for him
2. What problems were there?
    - Lack of time, labour and logistical issues were common challenges mentioned by all producers.
    - "Nothing we could not work with but number of mobs posed an issue but that was not just trial, I always split up in small as possible, mob size"

- One producer commented that although the small mob sizes created by drafting off ewes for preferential feeding did create complications in management, the positives outweighed the negatives.

3. What solutions were there, if any?
    - Plan events ahead of time
    - Communicate with other farm staff about the process and time commitment involved

4. Is there anything you would do differently next time?
    - One producer commented that the only thing he would do differently next time is weigh ewes earlier, 6 weeks before joining to allow appropriate management changes to be done more efficiently, however harvest is generally occurring at this time which makes things difficult. This producer is also using the methodologies in this trial, on other ewes on his farm, that are not in the trial.
    - Take the time before the ewes were in the yards (e.g. the night before ewes are to be yarded) to set up the XR as required, to improve work flow whilst the animals are in the yards.

Core producers also completed an exit survey following the final presentation of results; the surveys are attached, and a summary is below:

Table 5. Core producers' answers to questions before and after the survey; if producers responded 'Yes', details are supplied

Farm	Do you weigh sheep?		What is your level of comfort with 'technology'[A]		Do you record data on individual animals?		Have you made decisions on this data?	
	Before	After	Before	After	Before	After	Before	After
1	Ewes & lambs	Ewes & lambs	9	7	Weight & scan result	Weights – ewes & 2nd lambers	"Select poorer preforming animals. Monitor weights to improve management with accurate data"	"To improve conception"
2	Lambs & hoggets	Lambs & hoggets	6	8-9	Weight & weight gain	Light/heavy	No	Culling & selection of ewes for preferential feeding
3	Before drenching & as required	Lambs & ewe lambs; condition scored rather	5	6	No	Scan result of ewes & heifers; weight gains of	No	Selecting ewes & cows to retain; paddock selection for finishing lambs

	than weighed ewes		calves & lambs	

[A]1-10; 1 being not at all comfortable, 10 being very comfortable

Table 6. Core producers' responses on a 1-10 scale (1 being no increase, 10 being a large increase) to questions about the effect of the PDS on their Knowledge and Skills

Farm	1	2 (stock manager)	2 (Manager)	3
Has this PDS increased your knowledge of the liveweight ranges of your ewes and what this means on your farm?	8	9	10	9
Has this PDS increased your knowledge of how your ewes might respond to preferential feeding?	8	9	8	9
Has this PDS increased your knowledge of the functions that your recording device (e.g. XR or similar) is capable of, i.e. what it can theoretically do?	7	9	9	9

In answer to the question: "Please briefly outline what you have learned about weighing and preferential feeding ewes – i.e. the 'take-home' messages for you", responses included:

- *It will make the mob more productive*
- *That the combination of separating poorer animals from the main mob as well as preferentially feeding them is an effective way to increase their condition whilst leaving them in the main mob without preferential feed results in continued decline in condition*

- *It reaffirmed to us why we do it, and in an enterprise where ewes are at the core it is one of the core management activities that drives successful results. The variation in live weight at the same CS really emphasized that CS is the critical element to measure.*
- *Weighing/Cs ewes, prior to joining can help increase scanning and marking % and weights. The preferentially feeding needs to be done far enough prior to joining to have effect.*

'Take-home' messages included

- *Preferential feeding of ewes will make the mob more productive*
- *That the combination of separating poorer animals from the main mob as well as preferentially feeding them is an effective way to increase their condition whilst leaving them in the main mob without preferential feed results in continued decline in condition*
- *It reaffirmed to us why we* (preferentially feed)*, and in an enterprise where ewes are at the core it is one of the core management activities that drives successful results. The variation in live weight at the same CS really emphasized that CS is the critical element to measure*
- *Weighing/Cs ewes, prior to joining can help increase scanning and marking % and weights. The preferentially feeding needs to be done far enough prior to joining to have effect.*
- *Weighing allows preferential feeding to be analysed and evaluated leading to better production results from our ewes.*

Comments from producers have indicated that they have appreciated the benefits presented to them in terms of changes in liveweight, condition score, scanning or marking percentage, or lamb weights, even though there was not always a demonstrable increase in these parameters during the PDS. Some comments from the producers include:

- *This has given us confidence to know that preferential feeding will work on a larger scale & is worth the investment in subdivision, etc*
- *We have been able to identify our better & worse performing ewes & record data against individual ewes, then able to preferentially treat better performing ewes*
- *Had nothing been done* (i.e. the ewes not been preferentially fed in January 2019)*, the result would have been worse. Conception was still lower (in the preferentially fed ewes) but it would have been worse.*

The producer on Farm 3 commented that the logistics of managing multiple smaller mobs of ewes (e.g. Monitor, Control and preferentially fed mobs) were difficult – however the manager of Farm 2 commented that seeing the figures on a small group of ewes gave him more confidence to carry out these changes on a larger scale, over the 8,000+ ewes on the farm. It must be noted that some of this data (e.g. scanning result, light or heavy body condition) can be collected without the use of eID, however eID does make it easier and more precise to measure outcomes of interventions.

1.4 Mackinnon Project Newsletter articles

1.4.1 **April 2018**

<u>Using eID to improve ewe performance – Dr Bea Kirk BSc BVMS MVSc</u>

Ewe bodyweight and condition have a significant effect on conception, marking percentage and lamb performance to weaning and beyond. In a 2015 MLA report, by Joe Lane and others, on the priority list of endemic diseases for the red meat industries, neonatal mortality was estimated to cost the industry $540m (or over $43,000 per flock) per annum. A significant number of these neonatal mortalities can be prevented by

improving ewe management. Pregnancy toxaemia, which also accounts for some ewe mortalities, was estimated to cost the industry $16m, or $1,200 per flock. The incidence of this disease can also be reduced by appropriate management of ewes.

A producer Demonstration Site (PDS) trial will soon commence in Western Victoria, which aims to use electronic ID (eID), now mandatory in Victoria, and its associated technology (e.g. tag readers & recording systems), to improve ewe performance and welfare.

Monitoring – why and how?

Through monitoring of ewes, producers can determine whether they are providing adequate nutrition and enables them to identify and appropriately manage ewes in suboptimal condition. Monitoring has traditionally been done by condition scoring or weighing a sample of ewes and managing the mob based on these observations. The number of producers' condition scoring ewes has increased since the delivery of the Lifetime Ewe Project, however some producers have since stopped condition scoring because of the time and skill involved. Electronic ID and associated software and hardware now makes monitoring and managing individual animals easier and more accurate by allowing producers to objectively monitor individual ewe weight change, as well as identify ewes that are either not performing, or consistently performing well.

Where does eID fit in?

Since eID has become compulsory for sheep enterprises in Victoria, many producers have purchased or received grants for equipment such as scales, monitors and tag readers which enable them to capture data. However, some producers are unsure how to use eID-related software and hardware to its full potential, or aren't sure how the data collected can increase the profitability and/or productivity of their flocks. This lack of understanding means producers are unlikely to invest in monitoring equipment.

The aim of this PDS trial is for producers to become confident with technology associated with eID, and more importantly, use the data generated by eID to improve the productivity and profitability of their sheep enterprise. This selection pressure can be used over a period of years, to remove the poorer performing ewes in a flock (e.g. ewes that repeatedly only rear one lamb). It can also be used in conjunction with technology such as Pedigree Matchmaker, which pairs ewes to lambs and allows an individual kilogram of lamb weaned per ewe to be calculated. More information on this is available from Agriculture Victoria: http://agriculture.vic.gov.au/agriculture/livestock/national-livestock-identification-system/nlis-sheep-and-goats/benefits-of-eid. However, this project will look at using the technology to aid management within one production year. Specifically, producers will be able to:

- Identify and appropriately manage any low bodyweight ewes or those losing weight;
- Look for differences in production of ewes and mortality of ewes and lambs between monitored and control mobs;
- Demonstrate a relationship between bodyweight & subsequent reproductive performance.

The trial will also involve analysis of lamb production between monitored and control ewes, and a cost-benefit analysis of purchasing eID-related software or hardware (given that the tags themselves are now cost-neutral), and monitoring ewes.

Trial method

A pre-trial workshop on using eID-related technology will be conducted, in association with Tru-Test™. The aim of this workshop is for producers to become more comfortable with using the technology, such as XR monitors and tag readers. This workshop is free of charge and open to Mackinnon clients. Please contact the office or Bea Kirk at kbeata@unimelb.edu.au to register your interest.

The trial itself will be conducted between weaning in 2018 and weaning 2019 on each farm. At weaning, a 'control' mob (no regular weighing, farm's usual practice) and a 'monitored' mob (ewes weighed regularly) of ewes will be set up on each farm. Within each farm, the control and monitor mobs will contain the same number of ewes (100-200) of the same breed, and same or similar age/parity (e.g. maidens, second-lambers, or mature ewes); however, mobs between farms will vary. This allows for variation between farms and enterprises, and allows producers to choose a group of ewes to monitor which they have experienced challenges with in the past. Pastures will be assessed and a best practice worm control program will be carried out for these mobs.

The monitor mob will be observed at key times until weaning 2019. The aim is to use existing handling times rather than increase handling of animals; the exact timing of weighing events will vary from farm to farm depending on the farm's calendar. A guide is in Table 1 over the page.

Ewes in the control mob will be weighed and condition scored at the start and end of the trial; for the rest of the trial period they will be treated as per the usual practice on each farm. The following things will be recorded: marking and weaning percentage, the number of dry ewes at marking, number of ewe deaths (ewes either found dead or permanently missing), and pregnancy scanning result.

Expected benefits

Improved management of ewe bodyweight will increase fertility and decrease ewe and lamb (and weaner) mortality and ill-thrift. Lifetime Ewe work has shown that a 1 kg increase in ewe bodyweight (up to condition score 3) will increase lamb marking by around 1.2% (Oldham et al, 2011). In the MLA report by Lane and others, it was calculated that reducing neonatal mortality by 5% would increase income by $132m industry-wide; and reducing it to industry recommendations (10% mortality for singles, 20% in twins) would increase income by $147m (before costs of altering management are considered). The net gain of reducing weaner ill-thrift and mortality to the recommended figure of 4% in all flocks would be $40m.

Welfare of ewes and lambs is also a major issue for producers and consumers, and effective monitoring of individual ewe weight (and therefore body condition) will improve welfare.

A cost-benefit analysis of weighing ewes and investing in equipment associated with eID will also be conducted. Producers' use of, and attitude to, eID and associated technology will be captured via a survey before and after the trial.

Conclusion

Given that electronic tags are now compulsory in Victoria and are now cost neutral, this should be viewed as an opportunity to explore the benefits it can bring to our individual enterprises, and industry as a whole.

Key points:

- Electronic identification (eID) offers opportunities to increase productivity and welfare of stock

- A workshop on using eID-associated technology will be conducted by Tru-Test™. Please register your interest to receive details.

- A trial will run from weaning this year, to quantify the welfare, production, and financial benefits of individual monitoring of ewes

1.4.2 **April 2019**

PDS on using eID to monitor ewes - Dr Bea Kirk BSc BVMS MVSc

A Producer Demonstration Site trial (PDS) on monitoring ewe bodyweight is now underway in western Victoria. Though the trial is in its early stages, and reproduction results (scanning, marking, weaning etc) are not yet available, the early results are promising – it may be possible to calculate a standard reference weight for ewes using bodyweight and condition score. Producers are getting more comfortable with how to use technology associated with electronic identification (eID) and working through some of the logistical issues associated with monitoring and managing ewes. This article summarises results to date and discusses the next steps.

Addressing trial aims

The aims of this project were for producers to become confident with technology associated with eID, and to use the data generated by eID to improve the productivity and profitability of their sheep enterprise. Specifically, we wanted producers to be able to:

- Identify and appropriately manage any low bodyweight ewes or those losing weight;

- Look for differences in ewe (and lamb) production and mortality between monitored and control mobs, and

- Show a relationship between bodyweight & reproductive performance.

So far, two or three bodyweights have been obtained from monitor ewes (at weaning, during the summer and/or before joining), and two field days have been held, which both received good feedback. Four of the farms are monitoring adult ewes, and the fifth is monitoring lambs which will be joined for the first time in 2020. This article discusses results from the adult ewes.

The bodyweights and condition scores of ewes are shown in Table 1. The bodyweights included are 'bare shorn' weights; that is, the weight of the ewe minus her fleece has been calculated based on the average weight of a full fleece of ewes on each farm, and time of shearing. In this way, bodyweight changes of each ewe can be examined without being influenced by wool growth.

Table 1. Ewes monitored, and bodyweight (minus fleece) and condition score at each observation during the trial

Farm	Ewes	Weaning BWt (CS)	Summer BWt (CS)	Pre-joining BWt (CS)
1	Composite maidens (2017 drop)	70.3 (3.4)	67.7 (3.1)	70.0 (mob ave 3.3)
2	Merino maidens (2016 drop)	53 (3.1)	52 (3.1)	61 (3.1) (24 light ewes only)
3	Merino 2nd lambers (2015 drop)	56.2 (2.9)		59.9 (3.1)
4	Merino 3rd lambers (2014 drop)	50.1 (2.9)		49.9 (2.9)

A standard reference weight

Condition scoring must be learned by operators and is subjective (there can be variation between operators), whereas weighing can be done by anyone (especially if gear is set up by someone else), is objective (no variation between operators) and more sensitive than condition scoring (i.e. it is easier to objectively detect weight loss or gain of even a few kilograms). However, we need to be careful that this doesn't confound us – weighing ewes when they are 12-24 hours off feed, after previously weighing them full, can look like up to a 5% weight loss. Table 1 shows us that average bodyweights in the Merinos on different farms were within about 6kg of each other. However, the variation in bodyweight of ewes on the same farm, of the same condition score, was often about 23kg. This is not new information, but really highlights that a 'one size fits all' approach to ewe bodyweight will not work. Individually identifying ewes, however, allows us to compare a ewe's bodyweight to what she should weigh when she is in condition score 3 – her 'standard reference weight'.

An equation to calculate a 'Standard Reference Weight' of each ewe is being developed; this equation allows for differences in ewes' body frame size. This standard reference weight can then be recorded electronically so that during weighing, each ewe can be compared to her standard reference weight and drafted off from the mob if too light (indicating that she is in suboptimal body condition). This would then give an opportunity for her body condition score to be assessed manually as an extra check – rather than condition scoring every ewe – and the ewe be preferentially fed, or treated as required (e.g. feet examined, etc).

Preferentially feeding ewes

Farms 1 and 2 were able to draft off light ewes during the summer and preferentially feed them. Table 3 shows the subsequent weight gain of the light ewes on Farm 1, compared to the main mob. Because all ewes are individually identified, we will be able to follow up these ewes at scanning and subsequently, to see what effect preferential feeding during this period had. This is very important – managing small mobs can be logistically difficult, so it needs to be worthwhile. If 'light' ewes continue to fall back even after being preferentially fed, then it may be worth culling them in the first instance, rather than allocating precious feed to them over the

summer/autumn. On the other hand, if we had information on these ewes' previous reproductive performance, we may have found that these ewes were light because they reared two excellent lambs – another use for eID.

Using technology

During the course of the trial so far, we identified that producers and advisors would benefit from some training in how to use the hardware commonly used in collecting data via eID. Whilst these tools are powerful, producers and advisors may be unaware of their potential (for example just how much pertinent information on animals can be displayed, even if nothing other than a previous weight is recorded on that animal); or be unfamiliar with how to actually use this hardware, or troubleshoot problems that may arise.

To illustrate this, producers were asked to describe what worked well when weighing and condition scoring ewes, and what they would do differently next time. Technology (tag readers, autodrafters, and the monitor box) and how all these items worked together were named as both things that worked well, and things that did not. This highlighted the need for a tutorial session on how to set up and use equipment and what features may be useful. This tutorial was conducted by Scott Davis of Datamars (formerly known as Tru-Test) in April and was well received.

Table 2. Average weight (calculated without wool) of main and light ewes on Farm 1 in January, then in February after light ewes were preferentially fed, and difference in weight gain during this time

	Main mob (194 ewes)	Lights (21 ewes)
Average bare shorn weight Jan 8	68.4	62.2
Average bare shorn weight Feb 19	69.9	71.1
Average of bare shorn weight change	2.0	9.0

Conclusion

This PDS is in its early stages; the coming year or so will give us much more information on how collecting data via eID can be judiciously used to improve productivity and welfare on farms. We will continue to work towards generating a standard reference weight for each ewe, and use this to draft off ewes that are in suboptimal condition. Furthermore, eID will tell us whether preferentially feeding these ewes makes a difference to their subsequent production, including scanning and marking results.

Key points:

- There was up to 23kg variation of ewes of the same condition score, within each flock
- An individual standard reference weight is being developed for each ewe & used to identify light ewes
- Preferentially feeding light ewes increased their weight and condition score; scanning & marking results will tell us more

1.4.3 **July 2019**

Assessing Conception Rate Response to Condition Score: Not So Simple - Dr Angus Campbell BVSc(Hons) PhD DipECSRHM

We have known for a long time that there is a clear association between condition score (CS) and ewe fertility. A cornerstone of modern ewe management is ensuring ewes meet CS targets before joining to ensure optimum conception.

Understanding conception rate responds to increasing ewe condition or weight at joining helps producers understand the benefit:cost of different feeding management options in terms of expected returns from lambs conceived and ultimately born. However, the degree to which conception responds to CS varies between farms, and producers are encouraged to measure the CS:conception response in their own sheep so they can more accurately predict how ewe conception rates will respond to feeding management.

Calculating the CS:conception response is not straightforward, and the magnitude of it may be incorrectly estimated if the wrong calculation method is used. This article gives examples of calculating a farm's ewe CS:conception response and discusses the consequences of getting the estimate wrong.

Effects of CS on ewe reproduction

One of the most important drivers of ewe reproduction is the relationship between ewe bodyweight (or condition score) at joining and the number of foetuses she conceives. Different figures are quoted but, on average, increasing ewe liveweight by 1 kg at joining results in about an extra 1.5–2% lambs born, equivalent to an extra 1.1-1.6% lambs weaned. In the *Lifetimewool Project* plot experiments, +1 kg ewe liveweight at joining resulted in an extra 1.7–2.4% lambs scanned during pregnancy at Western Australian and Victorian farm sites, respectively.

Based on these figures, the Lifetime Ewe course described that +1 CS of ewes at joining equated to an extra 20% lambs conceived. Since 1 CS is equivalent to about 7-10 kg liveweight, depending on a ewe's frame size, this observation is consistent with the weight:conception rate figures quoted above. However, the *Lifetimewool* experiments also noted a lot of variation between properties around this average relationship, with sheep on some farms conceiving an extra 40% lambs per +1 CS (+1 kg ≈ +5.7% lambs scanned) but others showing no response at all. This difference is due to differences in genetics and time of joining.

Calculating a flock's unique CS:conception figure

Because of the variability in the conception rate response of an individual flock to changes in ewe liveweight at joining, it is recommended that producers calculate their flock's own response curve. This usually involves condition-scoring at least tagged 100 ewes at joining, recording their individual scanning results (empty, single, twin, etc), calculating the average conception rate (foetuses per ewe) for each condition score category, and drawing a trend line that best fits the data points.

Devil in the detail

There is a problem with doing that though: small differences in the conception rate of the outlier condition score categories (i.e., very light or very heavy) tend to have excessive influence on the slope of the trend line, and thus the conception rate response to liveweight/CS that is calculated.

Bea Kirk's MLA-funded *Using eID to Improve Ewe Monitoring* Producer Demonstration Site has also shown the challenges of obtaining this data in the first place. Even before the statistical complexities are taken into account,

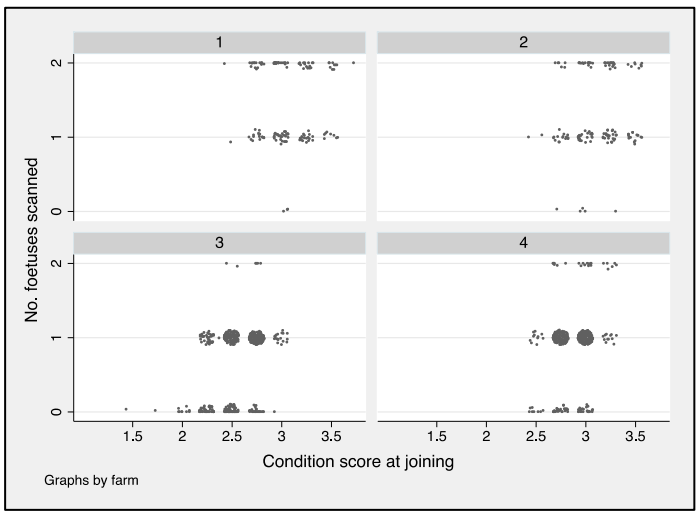


Figure 1: Examples of raw scanning data used to estimate CS:conception rate relationship on four different farms

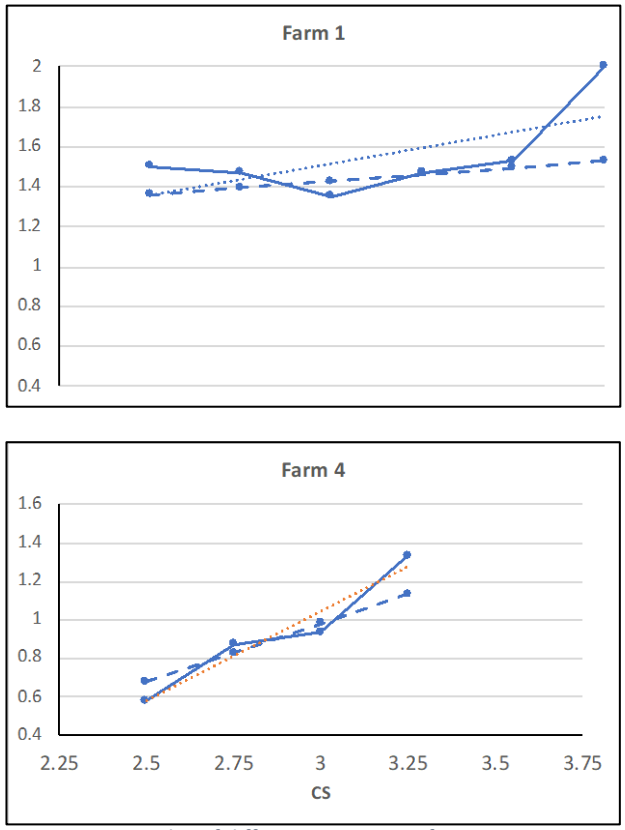


Figure 2: Examples of different estimates of CS:conception rate relationships without (dotted line) and with (dashed) correction for number of ewes measured in each CS category. (Actual data: solid line)

producers often do not have the time—or find it technically difficult—to download this data from automatic weighing systems and get it into a form that can be analysed appropriately.

Figure 1 shows some examples of raw scanning data for different sheep flocks, including a variety of breeds and ewe ages. Each dot represents a result from an individual ewe and has been 'jittered' slightly so that the number of observations in each CS:scan category can be seen better. For example, on Farm 4, the darkest patch of dots shows that most ewes conceived single lambs and calculate the average conception rate in each CS which are shown in Figure 2. The slope of these 'best rate that would be expected with a change in CS.

But Figure 2 shows that drawing these trend lines is not line, say using Microsoft Excel, the spreadsheet does not heavy, and just tries to fit the line evenly between all However, if the number of ewes in each CS category is trend line, different estimates are obtained (the dashed

Average conception rate (foetuses scanned/ewe)

were CS 2.75 or 3.0. This information is used to category and draw a trend line, examples of fit' lines gives the average change in conception

straightforward. If you just plot a 'simple' trend know how many ewes were very light or very points. These are the dotted lines in each figure. mathematically taken into account in drawing the lines).

Comparing the two approaches using the data from Farms 1–4 shown in Figure 1, produces quite variable results. Using a 'simple' trend line without accounting for numbers of ewes in each CS category over-estimates the CS:conception relationship up to two-fold on Farms 1 and 2. On Farm 1, the 'simple' estimate—the dotted line that is created when Microsoft Excel is used to fit a trend line—suggests a modest conception response to increasing CS (Figure 2). However, the correct relationship is actually much weaker, as shown by the much flatter dashed line. On Farm 3, the 'simple' technique appears to *under*-estimate the relation-ship by 20% but it is the opposite way around on Farm 4.

<u>When does this really matter?</u>

The examples above confirm that some farms have much stronger fertility responses to improving ewe CS than previously thought. This is a great observation and can be a driver of productivity. However, make sure that this relationship is real and not an artefact of the measurement and calculation methods used to estimate it. An over-estimate might encourage a producer to feed aggressively to increase fertility, when it might actually not be as profitable.

Assessing the relationship between ewe reproduction and CS or liveweight in your own flock is very worthwhile but keep the calculation issues in mind when you do it. Many producers likely have the data to estimate their own flock's response curve already, in the form of liveweight and/or CS inputted along with scanning results on their scales' indicator boxes. This is a valuable resource to help fine-tune management decisions but needs to be analysed correctly to make sure that inaccurate decisions are not made. Please contact your Mackinnon Project consultant if you would like more information or assistance uploading your current data, analysing it and implementing the results in your enterprise.

Key points:

- The relationship between ewe conception rate and CS varies between farms
- Producers can estimate the CS:conception effect in their own flocks
- A correct estimate should take into account how many ewes were measured
- Using simple trend lines based on average CS figures may incorrectly estimate a flock's fertility response to changing CS

1.4.4 **December 2019**

Using eID in commercial sheep enterprises - Dr Bea Kirk BSc BVMS MVSc

A Meat and Livestock Australia funded Producer Demonstration Site (PDS) looking at using electronic identification (eID) to help monitor ewes has now been running for 12 months in western Victoria. This article follows on from the article in April and discusses results from three farms to date; specifically, whether weighing ewes more frequently improves their production, and whether preferential feeding of lower condition score ewes before joining, improves their production the subsequent year.

Does weighing ewes more frequently improve their production?

The idea behind more frequent weighing in this PDS is that it allows us to track bodyweight gain or loss in individual ewes, and can make us more aware of weight loss earlier, and help us make changes to ewes' feeding if required. Compared to condition score, weighing is more objective (less open to interpretation or differences between operators) and does not require the skill of condition scoring (though there is also skill involved in setting up and operating scales and automatic drafters!).

In this PDS, ewes in the Monitor mob were weighed at weaning 2018, then before joining, at scanning, pre-lambing, marking and weaning, whereas the ewes in the control mob were generally not weighed, as per usual farm practice. Both mobs had similar nutrition (feed or pasture availability and type). Results (average condition score, marking %) of the monitor and control mobs can be compared to see whether the monitor ewes performed better than the control ewes.

In Table 1 below, we can see that the monitor mobs in this trial had a higher scanning percentage than the control mobs on all three farms, though Farm 2 was the only one with a (statistically) significant difference between the number of ewes scanned pregnant with a single lambs vs twins. The marking percentage was also higher in the Monitor ewes than the controls on Farm 1 and 2. Interestingly, the Monitor ewes on Farm 3 lost weight during joining, whereas the Control ewes maintained their weight (data not shown), which may have accounted for the lower marking percentage in the monitor mob. Though the lambs of monitor ewes were on average heavier at weaning than lambs of control ewes, this was either not significantly different, or did not translate to a higher kg lamb weaned per ewe in the monitor mob. Therefore, the differences we are seeing are small and, at this stage, do not convincingly justify the extra work involved in weighing ewes repeatedly.

Table 1. Comparison of Monitor and control mobs on all 3 farms

Group	Farm (ewes & year born)	2018 Weaning BWt[A] (CS[B])	Scan %[C]	Dry %[C]	Mark % (lamb Bwt, kg)	Lamb Weaning Bwt (kg lamb weaned /ewe)	Ewe 2019 wean Bwt[A] (CS)
Control	1 (Composite 2017)	69.8	163	8	142 (20.8)	32.5 (46.0)	pending
Monitor		70.2 (3.4)	173	5	150 (20.4)	33.3 (49.9)	pending
Control	2 (Merino 2016)	53	108	4	88 (14.5)	27.1	64.7
Monitor		53 (3.1)	120	3	93 (14.3)	26.4	64.5
Control	3 (Merino 2015)	54.8	124	2	115 (19.8)	28 (31.5)	not weighed
Monitor		56.2 (2.9)	139	2	101 (21.5)	29.5 (28.9)	59.9 (2.8)

[A] weights are 'fleece free' and in kg; [B]CS = condition score; [C] Compared to no. ewes at start of trial

<u>Does preferentially feeding ewes improve their performance?</u>

Research shows that preferentially feeding light ewes can have benefits if these ewes are light because they have been productive (e.g. rearing multiple and/or heavy lambs). The argument here is that if these ewes are fed to achieve condition score 3 again by joining, they will have the opportunity to be productive again the following year.

Two of the farms involved in this project were able to preferentially feed lower body condition score ewes for a month prior to their subsequent joining. Table 2 compares the lower condition score ('light', preferentially fed) and adequate condition score ('ok', fed as per usual practice on the farm) ewes in terms of their bodyweights, scanning results and percentage of ewes scanned pregnant but found not to be lactating at marking ('wet-dry'). In both cases, 'light' ewes (in condition score 2.5 or below, and/or below their calculated target weight) were drafted off in January and preferentially fed for a month, until joining. The ewes on Farm 2 grazed a fodder crop, whereas the ewes on Farm 1 were fed on a mix of lucerne and phalaris.

The light ewes gained weight on both farms, but on Farm 2 these ewes had lost weight again by the end of joining and had a lower scanning percentage, and higher wet-dry percentage at marking. On Farm 1, the preferentially fed ewes maintained the weight they had gained through to marking, but still had a higher percentage of wet-dry ewes than the main monitor mob.

Table 2. Bodyweights, scanning percentages and 'wet-dry' % of preferentially fed and ewes in adequate condition

Farm	Group & no.	January BWt (kg)[A]	Pre-join BWt (kg)[B]	Post join BWt (kg)	Scanning %	Pre-lamb BWt (kg)	% dry at marking	Final BWt (kg)[C]
1 (Composite)	Light (21)	61.7	70.3	73.9	205%	73.7	14%	80.3
	Ok (194)	67.9	69.0	72.7	166%	72.1	1%	82.1
2	Light (22)	47.7	61.5	53.5	109%		23%	62.3

Unfortunately, it was not possible to identify lambs to ewes, to know whether these light ewes reared more kg of lamb compared to ewes in the rest of the monitor mob. It is also possible that the ewes on Farm 2 would have responded better had they not had a feed change, and also worth noting that these ewes would have performed better than if they had not been preferentially fed.

A place for eID on farms

Now that eiD is mandatory, it can be a useful way to collect data on farms, with the proviso that this data is quick and easy to collect and will be useful at a later date.

One of the main challenges involved has been the logistics and workload of weighing ewes (and lambs) during already busy time periods (for example, lamb marking). Therefore, there needs to be a clearly demonstrated production benefit from weighing animals, which has not always been the case in this trial. Furthermore, weight is sensitive to changes due to wool growth, gut fill, and foetal weight.

One of the benefits of eiD in this trial is that it has been able to be used to demonstrate the effect of changes in feeding on bodyweight, and then the effect of bodyweight on performance.

Another important benefit is that farmers have become more familiar and comfortable with using technology (such as monitor boxes, readers etc), including using features that are useful to them. Some valuable information can be gathered in the yards by changing simple settings; for example showing a previous weight or scanning result of an animal when its tag is scanned.

A field day will be run in early February in conjunction with Agriculture Victoria that looks at the best way to capture and record pregnancy scanning data, and how to increase the accuracy of scanning. The results of this PDS will also be presented. To register your interest, please contact Bea Kirk: kbeata@unimelb.edu.au

Key points:

- Weighing ewes more frequently can sometimes, though not always, improve condition score and lamb production

- Increased monitoring needs to be achievable both 'in the yards' and managing the data after collection

A field day on pregnancy scanning and data collection will be run in conjunction with Ag Vic in early 2020

1.4.5 **May 2020**

An MLA-funded Producer Demonstration Site trial (PDS) in western Victoria is almost complete. Producer Demonstration Sites aim to increase the rate of adoption of key management practices and technologies that improve business profitability, productivity and sustainability through livestock producers pursuing new skills, management practices in their own commercial livestock production systems. This trial has been investigating whether using eID to record data on individual ewes, and weighing them more frequently, can improve their production. Some interim results are discussed in this article.

Preferentially-fed ewes' subsequent performance

Using eID has allowed us to look at what effect preferential feeding of light ewes has on those ewes, after they have been returned to the main mob. These results are shown in Tables 1 and 2.

Producers on these farms preferentially fed some monitor ewes during the summer of 2018-2019, grazing them on better quality perennial pastures (Farm 1), or a Brassica fodder crop (Farm 2) for a month before joining. On Farm 1, the ewes gained weight during the preferential feeding period, and maintained this until marking when they again became lighter; this could be because these ewes have a better lactation than their 'heavy' counterparts, and they may have reared heavier lambs through to weaning, though unfortunately the lambs of these light ewes were unable to be identified during the trial. On Farm 2, whilst the light ewes gained almost 14kg between early January and joining in February, they soon dropped back to being lighter than the rest of the monitor mob. However, increasing these ewes' bodyweight by preferentially feeding prior to joining would have increased the number of lambs marked by these ewes (there is a 3.6kg decrease in the difference between the light and heavy ewes between early January and post joining; i.e. from 5kg lighter to 1.4kg lighter); an increase in lamb marking percentage of more than 4%, if an extra 1kg of bodyweight leads to 1.2% lambs marked. In fact, the monitor ewes marked 93% lambs, compared to the controls which marked 88%. Given that these ewes were preferentially fed by paddock allocation rather than feeding extra grain, the cost involved in preferentially feeding would have been an opportunity cost (not grazing other classes of stock on those better pastures) rather than a direct cost.

Other findings from preferentially feeding

Two more important points arose here: firstly, that the average bodyweights of the 'light' ewes on both farms, when viewed retrospectively, were already lower than the other monitor ewes at weaning. Therefore, producers are likely to be at an advantage if they draft off light ewes at weaning for preferential feeding, when pasture quality is better.

Furthermore, the light monitor ewes on Farm 2 at pre-joining were around 9kg heavier than the heavy monitor ewes in January, but had the same condition score as the heavy ewes had had. This indicates

that *average* bodyweight *on its own*, with no reference to condition score or frame size of the ewe, may be misleading in assessing ewe condition.

Cost-benefit analysis

A cost-benefit analysis of weighing ewes was carried out by considering the labour cost involved in weighing ewes and comparing the number and weight of lambs of monitor and control ewes. According to the calculations (labour cost of weighing was $42.65 per 100 ewes, and an extra 8.2 lambs were weaned per 100 ewes; for an income of $682.81 using 10 year average prices, or $738.62 using 5 year average prices), on Farm 1 there was a 1600-1700% return on investment for weighing these ewes, using 10-year average and 5-year average lamb prices. Farm 2 had a 600-650% return on investment (labour cost of weighing was $60.56 per 100 ewes, and an extra 5 lambs were marked per 100 ewes; for an income of $362.25 using 10-year average prices, or $391.86 using 5 year average prices). This is a significant return on investment for the time taken, and demonstrates that regular weighing (and condition scoring in some cases) of ewes can be of great benefit in a farm system.

However, on Farm 3, a significant number of monitor lambs were lost between scanning and weaning (much more than expected based on the lamb survival rate in the control mob). This loss

Table 1: For Farm 1 (Composite ewes), average 'fleece free' bodyweights (in kg) of 'light' and 'heavy' monitor ewes, from weaning 2018, and the difference between average bodyweight of light and heavy groups.

Group	Wean 2018	Jan 2019	1.1.1.1.1 re-join 2019	Rams out	Scan	Pre-lamb	Mark	Wean 2019	Pre-join 2020	Rams out
light	63.7	61.7	70.3	73.9	68.3	73.7	80.3	74.8	82.1	85.3
heavy	70.8	67.9	69.0	72.6	67.3	72.1	82.0	79.8	84.7	86.5
Difference: light - heavy	-7.1	-6.2	1.3	1.2	1.0	1.6	-1.8	-5.1	-2.7	-1.2

Table 2: For Farm 2 (Merinos), average 'fleece free' bodyweights (in kg) of 'light' and 'heavy' monitor ewes, from weaning 2018, with condition scores in brackets, and the difference between average bodyweight of light and heavy groups.

Group	Wean 2018	Jan 2019	Pre-join 2019	Rams out	Scan	Mark	Wean 2019	Post wean	Pre-join 2020
Light (22 ewes)	48.4 (2.8)	47.4 (2.7)	61.2 (3.1)	53.2 (3.1)	44.5 (2.9)	58.2 (3.1)	61.9 (3.5)	63.6 (3.8)	55.6 (3.0)
Heavy (139 ewes)	53.3 (3.1)	52.3 (3.2)		54.5 (3.3)	46.1 (3.1)	61.8 (3.4)	64.4 (3.9)	65.8 (4.0)	56.7 (3.2)
light – heavy	-4.9	-5.0		-1.4	-1.5	-3.6	-2.5	-2.2	-1.1

was unexpected, and a paddock effect may have contributed to higher than expected lamb losses, despite good nutritional management of the ewes.

Overall, across the three farms, the return on investment for time spent weighing ewes trends in favour of the monitor mob, but, as is always the case on commercial farms, there are many factors at play. Another caveat is that only the labour cost of the time spent actually weighing ewes was taken into account (the ewes were already in the yards, so mustering time has not been included). What is difficult to quantify is the opportunity cost of both feeding (as discussed earlier in this article) and time – e.g. time spent weighing rather than conducting repairs and maintenance, sowing or spraying pastures, or in another enterprise.

eID in a commercial enterprise

The producers involved in this trial have reported that they have benefited from participating. Now that eID is mandatory in Victoria, these guidelines may be helpful in order to maximise its potential and minimise extra work:

- Be aware of what data you will benefit most from, particularly for minimal or no extra effort. For example, data that requires additional steps in order to become useful (e.g. analysis using Excel or another program) is less likely to see the light of day or be used, compared to data that can be collected with minimal extra effort and analysed or recalled automatically by the monitor.
- Get to know the key functions of data recording devices that would be most useful to your enterprise. This can be done by using additional resources (including online fact sheets and information days or sessions, or a phone call to your consultant or product representative).
- Become more comfortable using these key features and functions and develop a routine or set up that works for you in your yards. The key to learning any new skill is practice. Through the course of the project, because producers have been asked to weigh animals when in the yards, they have practiced and become more comfortable using the features of the XR, when they otherwise may not have used these features.

Next steps for the project

The final data collection point will occur at scanning, followed by the complete analysis of the differences between monitor and control ewes, and cost benefit analysis. The results will be presented in this newsletter as well as in other formats.

Key points:

- Preferential feeding had benefits on both of the farms which preferentially fed ewes during the summer

- On two out of three farms, there was a significant benefit associated with using eID to monitor ewes.

- Learn which data can be easily collected and used to benefit your enterprise the most, and how to do this

1.4.6 **November 2020**

MLA-funded Producer Demonstration Sites (PDSs) aim to increase the rate of adoption of key management practices and technologies that improve business profitability, productivity and sustainability through livestock producers pursuing new skills, knowledge and management practices in their own commercial livestock production systems.

A PDS facilitated by the Mackinnon Project running on three farms in western Victoria is now complete. This trial ran for 18 months, or 1.5 production cycles, and investigated whether using eID to record data on individual ewes, and weighing them more frequently, can improve their production over this time period.

The other critical aspect of this project was how eID can be used successfully in commercial sheep flocks, and what barriers exist to its adoption. This article follows on from the May newsletter article by discussing the main 'take home' messages from the trial, and overall learnings from the project.

Initial findings

It should be noted that though eID allows the collection of data, such as whether ewes are light or heavy, and pregnancy scanning result, this information can also be collected in other ways – therefore, we can look at eID and its associated technology as a tool that facilitates the collection of this data, and makes it easier.

One of the critical first findings in this trial was that even when condition scored to a quarter of a condition score, there was around 23 kilograms range in bodyweight of ewes in Condition Score 3 *on each farm, within an age group of ewes.* This is consistent with previous findings in other studies so was not unexpected, but really brings home the variation within a mob. This should be taken into consideration when calculating the Standard Reference Weight of ewes in your flock.

Furthermore, there was an occasion when the bodyweight of a group of ewes was around 14kg heavier than their cohorts had been, at the same condition score. Therefore, some reference should be made to condition score when ewes are weighed, because bodyweight on its own may be misleading as it depends on many factors, including fleece, foetal weight, age or growth of the ewe, and gut fill, including time off feed and the nature of the feed ewes are grazing (e.g. fodder crop vs dry pasture).

Standard Reference Weight

These factors all raise the issue that calculating a standard reference weight for individual ewes in a mob is complex and has many variables. Nevertheless, it has the potential to aid monitoring of ewes, if an accurate SRW can be calculated. This data can then be uploaded onto an XR5000, and ewes below this weight automatically drafted off.

Early on in this project, a standard reference weight was calculated for each monitor ewe, using a paired bodyweight and condition score, and allocating a number of kg per condition score. Using this equation, which was derived after the first visit for the project, the condition score of each ewe was predicted at a future visit, using the change in bodyweight since the first visit.

This was variably successful; between 16-70% were able to be predicted to ±0.25 of a CS; and 33-90% of ewes were able to be predicted to ±0.5 of a CS. This is a reasonable result, given that some of these weights were up to a year or longer since their initial weighing.

Furthermore, the average SRW of ewes in the monitor mob also increased during the course of the project, as the ewes got older; on Farms 2 and 3, where ewes were condition scored at each visit, the SRW increased by around 5kg for Merino ewes between 2.5 years and 4 years of age; and 1.8kg for Merino ewes between around 3.5 and 5 years of age. This has significance when planning feed intake.

Is monitoring ewes worthwhile?

During this PDS, the monitor ewes scanned or marked more lambs than the controls on some occasions, but not others. The monitor ewes tended to be heavier than the controls when they were late pregnant or lactating; i.e., when they were under more pressure.

It is important to note that the summer and autumn in Year 2 of the trial (i.e. early 2020) were remarkable in this area, with decile 8-9 rainfall received for January through to April, inclusive. Therefore, both control and monitor ewe condition was higher than it would usually be, and ewes on Farms 1 and 2 were on green feed leading up to and during joining.

There is certainly an argument here for continuing to monitor ewes' condition score, with or without bodyweight, even during good seasons, as it can help give confidence around decisions on feeding and utilisation of any extra feed (for example making hay). This is similar to what is sometimes observed when producers begin to weigh weaners regularly – problems with this age group decrease (and production increases), but when monitoring is ceased, problems increase and production decreases again!

Cost-benefit Analysis

As an update on the cost-benefit analysis since the May article on this project, on three out of six occasions, there was a positive ROI for the time spent weighing monitor ewes and preferentially feeding them; the ROI on these occasions varied between 2.5 times, to 5 times. This is not dissimilar to a desktop study on the long-term use of eID in commercial Merino and composite flocks, by Dickson in 2019, where the average return on investment obtained was $4.12 for every dollar invested, over 5 years.

The negative ROI which occurred on three of the six occasions illustrates the complexity of commercial enterprises, and that many factors contribute to a result; for example, the excellent start to 2020, as discussed earlier, may have had an effect on the lack of difference between the monitor and control mobs.

Preferentially fed ewes

One of the main aspects of this PDS was to look at what effect the preferential feeding of light ewes had on the performance of those ewes, after they were returned to the main mob. Light ewes were drafted off from the Monitor mob in January on all three farms (in Year 1 for two of the farms, and the second summer of the project for the third farm). Electronic ID made it easier for producers to

look at the performance of these ewes, before and/or after the preferential feeding (depending on when in the trial it occurred), to know the value of this for their operation.

A key finding was that looking back, all ewes that were drafted off in January had already been lighter than the rest of the mob at weaning. Therefore, there is the potential to identify these light ewes earlier, when pasture quality is better, and therefore supplementary feed is cheaper, and allow ewes to gain weight gradually over a longer period of time and prevent further weight loss.

On Farm 3 (Merinos), the only farm where ewes were preferentially fed in the second summer, (when their performance in the previous year was known), the light ewes had a higher scanning percentage than the heavy ewes (152% vs 130%), and were a similar weight as the heavy ewes until lactation. Therefore, we can assume that these ewes produced more kg of lamb per ewe, than the heavy ewes – so these light ewes were our more productive ones, and well worth preferential feeding.

Even on Farm 2, when the light ewes still had a lower scanning percentage after preferential feeding (109%, with 5% dry, vs 124%, with 3% dry), the result is likely to have been better than if no preferential feeding occurred.

Overall outcomes

As stated earlier, one of the key aims of a PDS is to increase the rate of adoption of practices on farms. This is crucial, because a practice must be practical to implement on farm, for producers to gain benefits from it.

The producers involved in the project were asked what they had learned or gained from this project, via an exit survey and discussions.

One of the benefits described was that the value of making management changes, such as preferential feeding, in their flock was able to be quantified, giving more confidence around implementing these changes across the whole flock.

Another outcome was that producers saw the benefit of condition scoring rather than weighing, because of the variability in bodyweights. This has demonstrated the value that the time taken to condition score ewes is worth it.

Producers were also asked what would help them record data, or make them more likely to record data. The responses indicated that more training in this area, or something that facilitated recording or analysis of data, such as an app, or someone to analyse and report on the data for them. This is crucial, because this project has shown that a negative ROI can also occur when monitoring ewes; therefore, if time is taken to collect the data, the data must be used in order to be of benefit.

Key points:

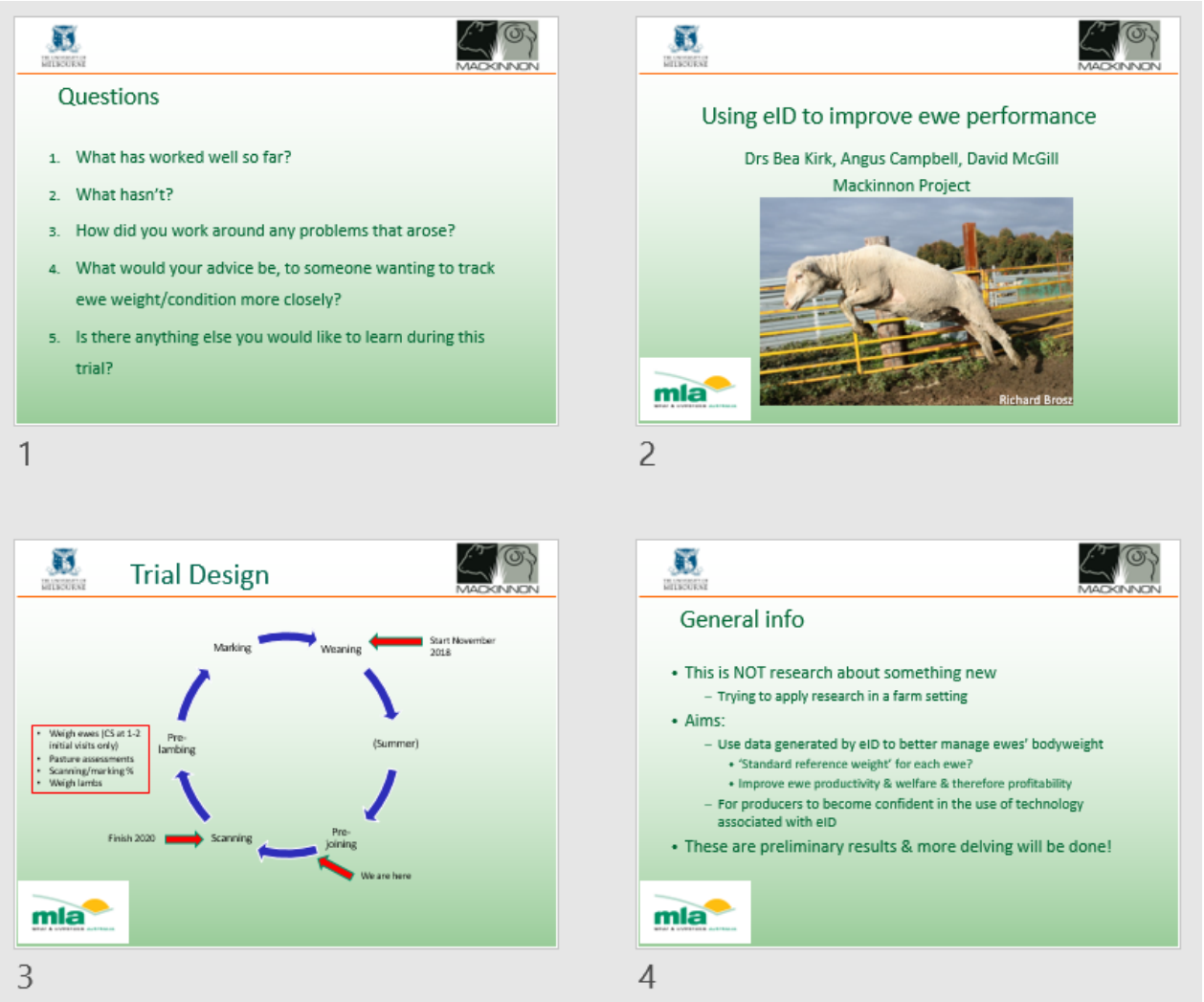
- Draft light ewes off at weaning rather than waiting until the summer
- Monitoring ewes and preferentially feeding light ewes can provide a good return on investment

- More training on the use of eID, or assistance with analysis of the data it generates, would be welcomed by producers

- eID can help enable gains & facilitate data collection, but is just one part of a complex farm system

1.5 Presentations

1.5.1 March 2019



Results so far

Farm	Ewes	Observation 1 Bare shorn BWt (CS)	Observation 2 BWt (CS)	Observation 3 BWt (CS)
1	Composite maidens (2017 drop)	Weaning (Nov) 70.3 (3.4)	January 67.7 (3.1)	Pre-joining 70.0 (mob ave 3.3)

5

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2	Merino maidens (2016 drop)	Weaning (Nov) 53 (3.1)	January 52 (3.1)	Feb 6 (light ewes only) 61 (3.1)

Bwt higher but CS the same – are these ewes larger framed?

6

Results so far

Farm	Ewes	Observation 1 Bare shorn BWt (CS)	Observation 2 BWt (CS)	Observation 3 BWt (CS)
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2	Merino maidens (2016 drop)	Weaning (Nov) 53 (3.1)	January 52 (3.1)	Feb 6 (light ewes only) 61 (3.1)
3	Merino 2nd lambers (2015 drop)	Post weaning (Nov) 56.2 (2.9)		Pre-joining (Jan) 59.9 (3.1)

Bwt higher but CS the same – are these ewes larger framed?

7

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4	Merino 3rd lambers (2014 drop)	Weaning (Jan) 50.1 (2.9)		Pre-joining (March) 49.9 (2.9)

Bwt higher but CS the same – are these ewes larger framed?

8

Results so far

Farm	Ewes	Observation 1 Bare shorn BWt (CS)	Observation 2 BWt (CS)	Observation 3 BWt (CS)
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4	Merino 3rd lambers (2014 drop)	Weaning (Jan) 50.1 (2.9)		Pre-joining (March) 49.9 (2.9)
5	Composite lambs (2018 drop)	Marking (Sept) 15.3 (Range 4.3-31.1kg)	Weaning (Nov) 30.1 (Range 8.5-49.3kg)	ADG 203g/day (Range -20 to 429g/day)

Bwt higher but CS the same – are these ewes larger framed?

9

Outcomes so far

1. Feeding ewes preferentially gives results
   - Farm 1 (Composite maidens):

	Main mob (194)	Lights (21)
Average bare shorn weight Jan 8	68.4	62.2
Average bare shorn weight Feb 19	69.9	71.1
Average of bare shorn weight change	2.0	9.0

10

Outcomes so far

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	Main mob (194)	Lights (21)
Average bare shorn weight Jan 8	68.4	62.2
Average bare shorn weight Feb 19	69.9	71.1
Average of bare shorn weight change	2.0	9.0

Will the 'light' ewes drop off again?

Will there be a difference at scanning/marking?

(Benefit to bother ratio!)

   - Farm 2 (Merino maidens):

	Jan 3		Feb 6
	Main mob (135)	Lights (24)	Lights
Average bare shorn weight	52.7	47.7	61
Average CS	3.2	2.7	3.1

11

Can we predict a ewe's 'ideal' bodyweight?

- Ultimate goal was to have a standard reference weight for each ewe at CS3
- Up to 23kg range in bodyweights of ewes within a condition score
- Need to allow for frame size & wool growth to calculate a target weight
  - Data points BWt1 & CS1
  - Divided ewes in each CS into lighter, middle and heavier third
  - Assigned 7, 8.5 & 10kg per CS for smaller, medium and large frame ewes
- To work towards this:
  - Validate equation by trying to predict CS2 based on BWt1 & CS1, & BWt2

12

Comparing predicted vs actual CS2

- On Farm 2 (Merinos):
  - 70% of ewes' CS predicted to ± 0.25 of a score
  - 92% predicted to ± 0.5 of a score
- On Farm 1 (Composites):
  - Adjusted kg to 5, 8.5 and 12kg per BCS for light, medium & heavy ewes
  - 56% of ewes' CS predicted to ± 0.25 of a score
  - 78% predicted to ± 0.5 of a score

Now how to get the XR to identify ewes below their target weight?

13

Average difference between predicted – actual CS2

Condition score at weaning	Lightest 33% of ewes	Middle 33% of ewes	Heaviest 33% of ewes
2.5	-0.09	-0.29	-0.51
2.75	-0.15	-0.26	-0.10
3	-0.09	-0.01	-0.21
3.25	-0.02	-0.09	-0.10
3.5	0.08	-0.12	-0.15
3.75	0.21	0.10	0.11

- Negative values: predicted condition score is less than actual
  - This is ok as we are underestimating a ewe's condition score: she is actually doing better than we thought
- Positive values: predicted condition score is more than actual
  - This is undesirable: we are potentially missing ewes that need to be fed better
- Conditional formatting: the lowest values are red, the highest are green
- This equation tends to underestimate the condition score of large frame ewes in low body condition
  - Tends to overestimate the condition score of small frame ewes in higher body condition

14

Using the XR

- Calculate the standard reference weight for each ewe
- Record this as her 'breed' in the XR
- Also set that figure as the target weight for each breed in the XR
- Set draft function to remove ewes that differ from their target weight

15

Other important outcomes

- Logistical issues
  - Time!
  - Managing small mobs
- Producers' level of comfort with technology is variable
- Some producers are unsure of what to purchase or how to use equipment to its full potential

16

1.5.2 **Sheepvention 2019**

Using eID to aid monitoring of ewes in western Victoria

Drs Bea Kirk, Angus Campbell, David McGill
University of Melbourne

1

Introduction

- This is NOT new research
  - Trying to apply research in a farm setting
  - Others are doing a similar thing in other locations
- These are interim results from one small trial to generate discussion about how we can best use new technology

2

Trial design

- Weaning 2018 → Scanning 2020
- **Monitor ewes:**
- Weigh ewes at management events (CS at 1-2 initial visits only)
- Light ewes drafted off for preferential feeding if possible
- **Control ewes:**
- Weigh at trial start, then business as usual
- **Comparing:**
- Scanning/marking %
- Lamb weights
- Ewe CS (whole mob) and mortality

3

Questions

1. Can we get an 'ideal weight' for each ewe?
   - Then autodraft on that weight
2. Does weighing ewes more frequently improve management of ewe weight?
   - Increased awareness of ewe weight change can change management practices (e.g. feeding)
3. Does preferentially feeding light ewes over summer pay off?
4. How does use of eID technology fit into a commercial sheep enterprise?

4

Farms & ewes involved

Farm no.	Breed	Age group	Approx no. (x2)
1	Composite	2nd lambers (2017 drop)	210
2	Merino	2nd lambers (2016 drop)	160
3	Merino	3rd lambers (2015 drop)	150
4	Merino	4th lambers (2014 drop)	120
5	Composite	Lambs (2018 drop)	

- Shelford/Rokewood/Skipton area
- Farms range from 2,000 to 10,000 ewes
- Range of use of technology
- Range of cash cropping area

5

Q1. Can we predict a ewe's 'ideal' bodyweight?

- Ultimate goal was to have a standard reference weight for each ewe at CS3
  - XR can be programmed to compare ewe weights to a set 'target' weight for each ewe and draft accordingly
  - Up to 23kg range in bodyweights of ewes within a condition score
- Need to allow for frame size & wool growth to calculate a target weight
  - Data points BWt1 & CS1
  - Divided ewes in each CS into lighter, middle and heavier third
    - Assigned them to small, medium and large frame size
  - Assigned 7, 8.5 & 10kg per CS for small, medium and large frame size

6

Predicted vs actual CS2

- Predicted CS2 based on BWt1 & CS1, & BWt2
- Farm 2 (Merinos):
  - 70% of ewes' CS predicted to ± 0.25 of a score
  - 92% predicted to ± 0.5 of a score
- Farm 1 (Composites):
  - Adjusted kg to 5, 8.5 and 12kg per BCS for small, medium & heavy ewes
  - 56% of ewes' CS predicted to ± 0.25 of a score
  - 78% predicted to ± 0.5 of a score
- Farm 3 (Merinos):
  - Adjusted kg to 9, 12 and 15kg per BCS for light, medium & heavy ewes
  - 54% of ewes' CS predicted to ± 0.25 of a score
  - 76% predicted to ± 0.5 of a score

What degree of accuracy is acceptable?

7

Q2. Does weighing ewes more frequently help management?

		Bare weights (kg)	Weaning (trial start)	Pre-join	Scanning weight	Scanning %	Pre-lamb
Farm 1 (Comp)	Control	69.8			64.2	172%	69.4*
	Monitor	+0.4			+3.3	181%	+2.9*
Farm 3 (Mer)	Control	54.8		56.7*	56.4	147%	57.4
	Monitor	+1.3		+4*	+1.2	144%	+1.4

- Farm 1
  - Monitor ewes 2.9kg heavier at pre-lambing (approx. 0.3 CS)
  - This is statistically significant
  - Monitor ewes scanned 9 percentage points higher than controls
- Farm 3
  - Monitor ewes significantly heavier at pre-joining then dropped off
  - Scanned lower than Controls

8

Q2 (ctd). Does monitoring ewes pay off?

Farm 2 scanning results

Scan result	Control	Monitor
Dry	4%	-1
Single	74%	-12*
Twin	20%	+13*
%	115%	128%

- Numbers of singles and multiples in controls and monitors are significantly different

9

Q3. Feeding ewes preferentially

Farm 1 results (Composite 2nd lambers)

- Light ewes in monitor mob drafted out 1 month after weaning
  - (>3kg lighter than their reference weight, & CS 2.5 or less)
- Preferentially fed for 1 month until just before joining

	Count	January (draft out)	Pre-join (put back)	Rams out	Scanning	Pre-lamb	Scan %
Ok	194	67.9*	69	72.7	67.4	72.1	177
Light	21	-6.2*	+1.3	+1.2	+0.9	+1.6	205

- Groups are significantly different in January but NOT at prejoin, rams out or scanning
- Preferentially fed ewes are still 1.6kg heavier on average
- Preferentially fed ewes had 28% point higher scanning than main monitor mob, and no dries

10

Q3(ctd). Feeding ewes preferentially

Farm 2 (Merino 2nd lambers)

- Light ewes (more than 3kg lighter than their reference weight, and CS 2.5 or less, drafted out 1 month after weaning
- Preferentially fed for 1 month until just before joining (feed change)

	Count	Weaning (bare wt)	January (draft out)	Pre-join (put back)	Rams out	Scanning %
Ok	139	53.7^{A}	52.7^{B}		54.9^{C}	133%
Light	22	-4.9^{A}	-5^{B}	62	-1.4^{C}	114%

- Weights with the same superscript letters are significantly different to each other
- Lots going on here!
- Feed change onto & off fodder crop?
- Light ewes performed worse but intervention may still have been valuable
- Weight gain then loss → lower scanning %?

11

Cost/benefit

- It takes time to weigh so what is the cost per lamb?

Farm	Time (hours)	Labour Cost ($)	No. extra lambs	Cost/lamb ($) (100% survival)	Cost/lamb ($) (80% survival)
1	3 (6 x ½ hr)	180	19	9.47	12 (15 lambs)
2	2.25 (3 x ¾ hr)	135	19	7.10	9 (15 lambs)

Farm 1: ewes are weighed routinely so really no increased cost
Farm 2: ewes condition scored as well as weighed
Assume 2 people to weigh, paid $30/hr each

- Also need to consider
  - Increased time involved with managing more mobs
  - Feed cost
  - Opportunity cost
  - Other enterprises & priorities

12

Q4. eID data in a commercial enterprise

- Logistical issues
  - Time!
  - Challenge in monitoring many individual animals & creating more management groups
  - Already stretched systems & multiple-enterprise farms
- Investment in technology
  - Initial outlay
    - Some producers are unsure of what to purchase or how to use equipment to its full potential
  - Ongoing investment in *using* the technology
    - Time
    - Other sources of knowledge/help
    - Practice, practice, practice

13

Take-home messages

- Increased weighing and/or preferential feeding has potential
- Getting a target bodyweight for ewes is possible
- Logistical challenges
  - Making time to get the data
  - Making time to manage the data
  - Managing the ewes based on the results

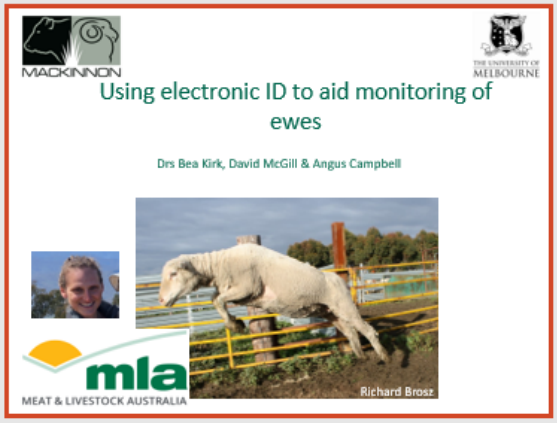
14

Thank you

- Meat & Livestock Australia (funding body)
- My colleagues at the Mackinnon Project, University of Melbourne
- Participating farmers

15

1.5.3 **eID-enabled ewes Webinar – 7th October 2020**



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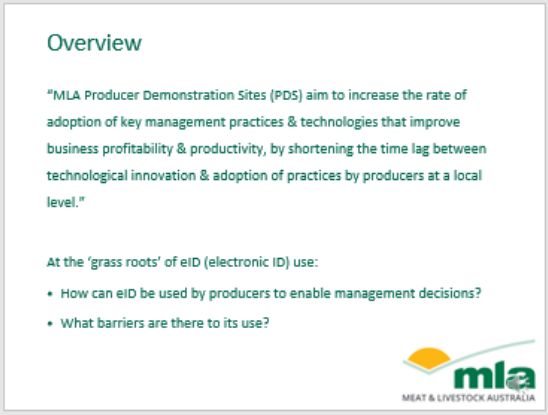
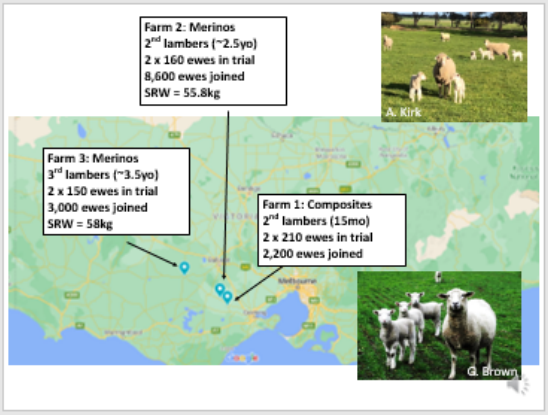


2 ★ 00:53



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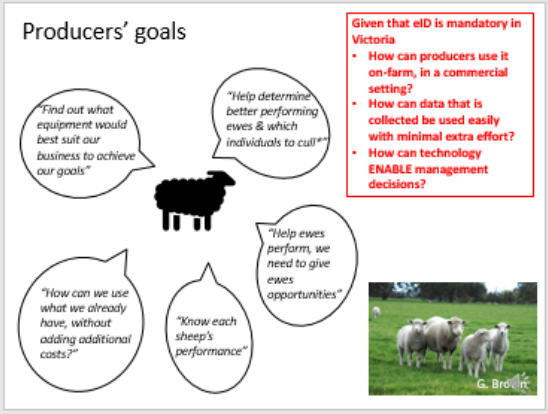


4 ★ 01:22

Questions

1. Does weighing ewes more frequently improve production?
   - Increased awareness of ewe weight change can change management practices (e.g. feeding)
2. Does preferentially feeding light ewes pay off?
3. How does use of eID technology fit into a commercial sheep enterprise?
4. Can we predict a ewe's individual target weight?
   - Then autodraft on that weight

5 ✭ 00:47

Trial design

Monitor ewes:
- Weigh ewes at management events (+/- CS) – by producers
- Light ewes drafted off for preferential feeding if possible

Control ewes:
- Weigh at trial start & end
- Scanning/marking %
- Weigh lambs

Decile 8-9 rainfall in January April inclusive!

6 ✭ 00:49

Q1. Does weighing ewes more frequently improve production?

- 23kg range in bodyweight at CS3
- Monitor ewes heavier & scanned/marked more lambs than controls at some times, & not others
  - Monitor ewes tended to be heavier when ewes were under more pressure e.g. late pregnant/lactating
- Monitoring during good seasons gives more confidence around other options/ opportunistic land use

7 ✭ 01:51

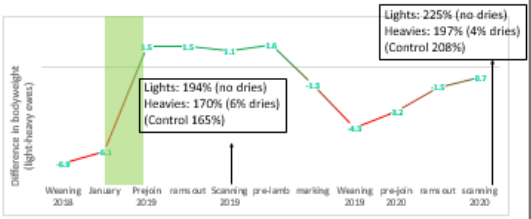
Q2. Does preferentially feeding light ewes pay off?

On Farms 1 & 2:

- Jan 2019: Light ewes in monitor mob drafted out 1 month after weaning
  - (>3kg lighter than their reference weight, & <CS 3)
- Preferentially fed for 1 month until just before joining

8 ✭ 00:30

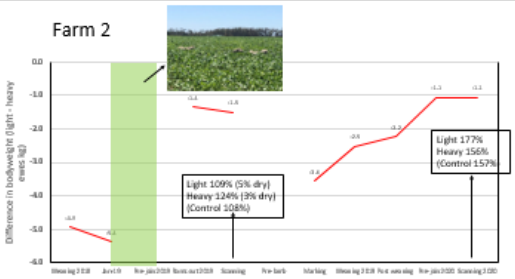
Farm 1



18 light ewes, 167 heavies

9 ★ 01:55

Farm 2



- 21 light ewes, 130 heavy ewes
- Same preferential feeding criteria & time as Farm 1, but on fodder crop

10 ★ 01:20

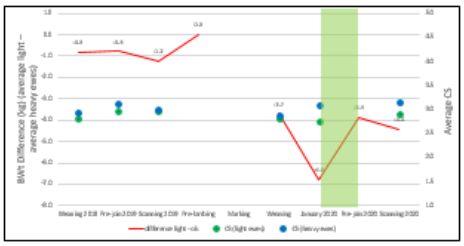
Farm 2

- 21 light ewes, 130 heavy ewes
- Note difference between average weight of light & heavy ewes at CS 3+
  - Need some reference to condition when weighing
- Wool production unknown

11 ★ 00:55

Farm 3

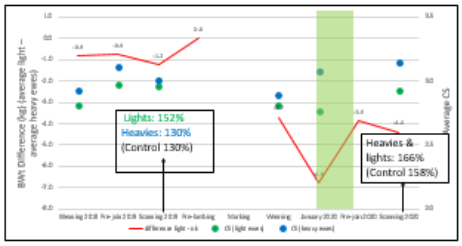
- Ewes <CS3 drafted off in late January 2020 & preferentially fed
  - 47 light ewes, 76 heavy ewes
- Able to look back & see what light ewes had done previously



12 ★ 01:13

Farm 3

- Ewes <CS3 drafted off in late January 2020 & preferentially fed



13 ★ 00:34

Summary: preferential feeding

"We have been able to identify our better & worse performing ewes & record data against individual ewes, then able to preferentially treat better performing ewes"

- Potential to cull 'repeat offenders' from the flock
- Interpret bodyweight alongside condition score & frame size
- Better to identify light ewes earlier (e.g. at weaning)

"Had nothing been done, the result would have been worse. Conception was still lower (in the preferentially fed ewes) but would have been worse"

14 ★ 00:52

How does eID fit into a commercial enterprise?

Return on Investment (ROI):

- Used time stamp function of XR to calculate duration of weighing
- Only the time weighing (not mustering etc) was included
- Lamb value based on a 10-year & 5-year average over the hooks (OTH) value, for light lambs (12-18kg CWT), assuming 45% dressing out
- Assume labour cost = $30/person/hr
- Assume equipment purchased for $22,000
  - 10% depreciation p.a. years = $2,200/year
  - Divide depreciation cost by no. ewes on farm = depreciation / 100 ewes
- Feed cost- opportunity/supplements/subdivision

15 ★ 01:45

Farm 1

- Single & triplet ewes lambed together so using overall lamb survival scanning to weaning, to calculate likely difference
  - 87% lamb survival
  - Extra 8.2 lambs weaned per 100 ewes in monitor mob
- Lamb weaning weight = average weight of all lambs (i.e. singles, twins & triplets)
- Divide depreciation cost / 2,200 ewes = $100 per 100 ewes
- 4.8x return on investment per 100 ewes for 10-year average prices (not including cost of marking extra lambs)
  - 5.1x ROI per 100 ewes for 5-year average prices
- Controls scanned higher in Year 2

16 ★ 01:03

Farm 2

- Higher labour costs – different yard set-up, & ewes condition scored as well as weighed
- Depreciation over larger no. of ewes
- Return on investment using marking %
  - Approx. 2.5x using 10-year average prices
  - Approx. 2.6x using 5-year average prices
- Similar scanning % in monitor & control mobs in Year 2

17 ✭ 00:37

Farm 3

- Year 1:
  - More lambs lost in monitor mob than controls – paddock effect
  - Negative ROI
- Year 2:
  - 5-5.5x ROI based on scanning %

18 ✭ 00:23

19 ✭ 01:19

Can we predict a ewe's individual target weight?

- Used ewe condition score & weight to determine frame size
- Then allocated no. of kg per condition score
- Predicting CS based on previous weight was variably successful
  - 16-70% able to be predicted to ±0.25 of a CS
  - 33-90% able to be predicted to ±0.5 of a CS

20 ✭ 00:52

Take-home messages

- **eID can help enable gains & facilitate data collection**
  - One part of a complex farm system
  - Efficiencies help!
- **Choose which data to measure based on your goals**
  - Minimal/no extra effort
  - e.g. weight change displayed on screen
  - Doesn't need to involve weighing sheep
  - e.g. scanning % over successive years, light/heavy status
- **Practice, hone, refine, & use it!**
  - Get comfortable & efficient

21 ✭ 01:38

Thank you:
- Meat & Livestock Australia (funding body)
- Host producers
- Ag Vic
- My colleagues at the Mackinnon Project & Andrew Kirk & László Gyarmati

Questions & discussion:
Gordon Brown, "Shelburn"
Pete Barker, "Warrambeen"

kbeata@unimelb.edu.au

22 ✭ 00:20