The development of a maternal ewe efficiency index for the Mount Ronan flock

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Background

The concept of maternal ewe efficiency is very topical within the Australian sheep industry today.

In modern prime lamb producing flocks, success is achieved by maximising profitability per hectare. The maternal ewe must be a highly efficient animal that can be run at high stocking rates and maximises lamb output in relation to feed consumption over the 12 month period.

Industry is using an index to describe ewe efficiency, the index being:

Ewe efficiency = <u>kg lamb weaned at 100 days</u>
ewe joining weight

In the Mount Ronan Maternal flock, utilisation of ASBVs over the last 12 years has resulted in the selection of fertile ewes with good growth and carcase characteristics.

We are looking to identify the most efficient ewes by quantifying;

1. The ability of ewes to produce their own body weight in lamb at 100 days
2. Ewes which are more moderate in size, but still produce fast-growing lambs
3. Ewes which are more resilient to live weight loss during lactation and periods of feed shortage

The ability of ewes to produce their own body weight in lamb at 100 days

The ewe efficiency indices calculated for the ewes in the Mount Ronan flock for the years 2013 to 2015 are reported in Table 1.

Table 1: ewe efficiency indices for the Mount Ronan flock from 2013-2015 joinings.

Year	n	Min	Max	Avg	Prop. >100%	Avg top 10%
2013	471	0 (53.6%)	216.1%	93.3%	45.5%	163.5%
2014	449	0 (25.8%)	143.7%	69.8%	11.8%	113.7%
2015	487	0 (41.7%)	187.0%	79.6%	32.0%	134.7%
Avg				81.1%	30.0%	137.6%

Over this 3-year period;
• The average ewe efficiency index was 81.1%, with a range from 25.8% to 216.1%
• 30% of ewes had an index greater than 100%
• The top 10% of ewes had an average ewe efficiency index of 137.6%
The average joining weight of the top 10% of ewes was 63.0 kg and they produced 85.5 kg lamb at 100 days.

Limitations of industry index

A limitation of this index is that is does not take into consideration the condition score (CS) of the ewe at joining. As there is significant variation in CS at the same live weight in any flock, due to both genetic and environmental factors, this index penalises ewes which are heavier due to being in better condition. We do not want to select against these potentially 'better doing' ewes.

For example, consider the scenario illustrated in Table 2 where there are three ewes of the same 75 kg joining weight but three different condition scores. If they each wean 75 kg of lamb at 100 days, then they all have an efficiency of 100%.
We can adjust their live weight (LW) to a standard CS of 3, in this case using the computation that one CS equals 10 kg. The resulting ewe efficiency index now favours the ewe that is heavier due to being in better condition, and penalises the leaner ewe. In effect, we are more likely to be rewarding a ewe with a smaller frame size.

Table 2: adjusted ewe efficiency index based on standardising ewe joining weight to condition score 3.

Ewe	Join WT	Join CS	100d kg LW	Efficiency	WT at CS3	New efficiency
1	75.0	2.5	75.0	100%	80.0	93.7%
2	75.0	3.0	75.0	100%	75.0	100%
3	75.0	3.5	75.0	100%	70.0	107.1%

Ewes which are more moderate in size, but still produce fast-growing lambs

At Mount Ronan, since 2013 we have been collecting paired LW/CS data for each ewe up to three times a year. Within the flock, we have recorded a variation of up to 60 kg in LW within ewes of the same CS (see Figure 1). This means that there is a lot of potential for selection of ewes with a more moderate adult size.

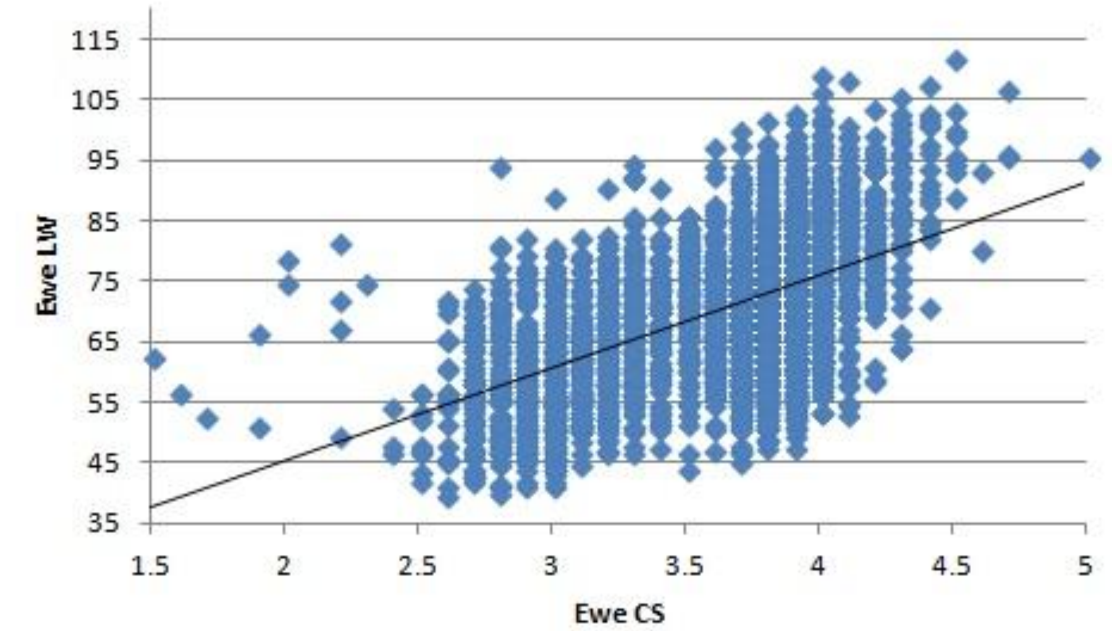

Figure 1: Paired LW and CS measurements taken from 2013-2015. P=0.000, R^2=0.2747 (from linear regression).

It has previously not been known how LW and CS relate to the kg of lamb produced at 100 days, but if we can reduce LW without compromising on lamb production, this will result in improved ewe efficiency.

The standard reference weight concept

The concept of a standard reference weight (SRW) is not new in the sheep industry. It is a method used to compare the mature size of sheep by using their LW at CS 3. This is usually done to look at the effect of CS on LW in different sheep populations (breeds, bloodlines).

In the Mount Ronan flock, linear regression of LW on CS indicates that there is a strong linear relationship between CS and LW (Figure 1; P=0.000). However, there is such a range in LW at each CS (R^2=0.2747) that flock SRW will not provide an accurate estimate for each individual ewe.

To address this problem, I used the paired LW/CS data to compute SRWs for each ewe. Paired measurements are plotted using a linear regression model to estimate the LW of the ewe at CS 3. For ewes with more than three data points, their estimated SRW is quite accurate (74% of ewes with R^2>0.6). Figure 2 shows the generation of an equation to estimate SRW for one ewe in the flock.

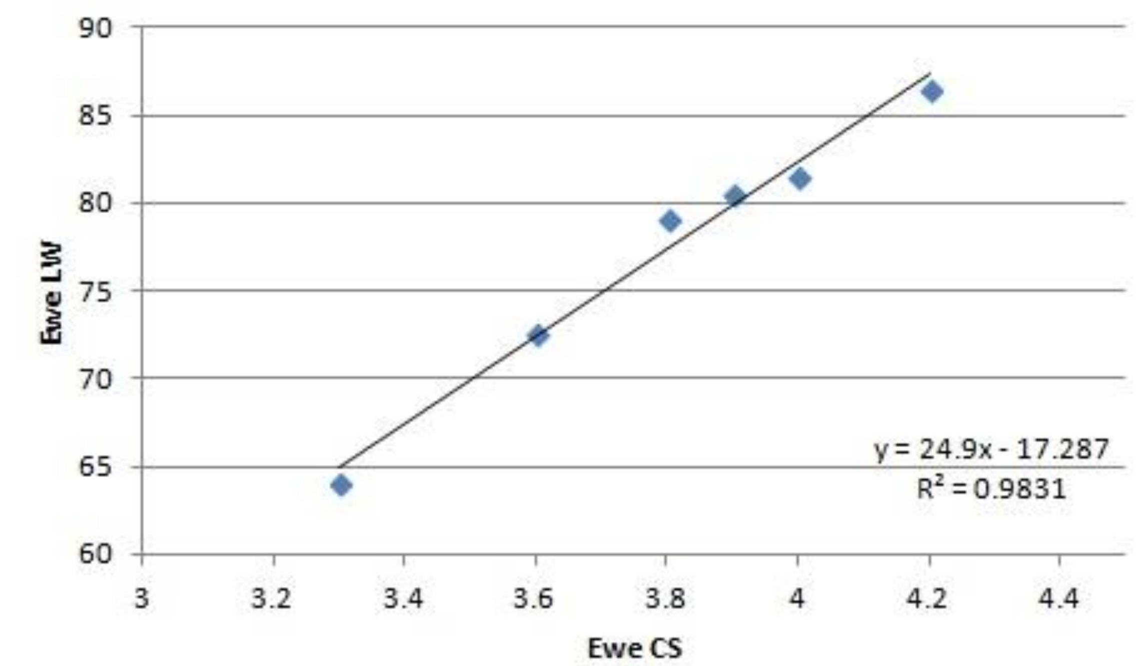

Figure 2: linear regression of paired LW/CS data for ewe 100608. Her resulting estimated SRW = 57.4kg.

Individual SRWs are then substituted into the original ewe efficiency index in the place of joining weight. I am also using multiple years' lambing data in the equation, giving an average efficiency rather than solely focussing on one lambing.

Modified ewe efficiency index =
<u>average kg lamb weaned at 100 days</u>
standard reference weight

This index is very much a work in progress.

Ewe efficiency and ASBVs for NLW and WWT

Analysis of the Mount Ronan data indicated that NLW had a significant effect on ewe efficiency (P=0.001). Table 3 shows that in both the Maternal and White Suffolk flocks, NLW was lower in the bottom 10% ewes and higher in the top 10% ewes compared to the group average. This is to be expected, as all the top efficiency ewes reared multiple lambs. It would be very difficult for a single-bearing ewe to achieve 100% efficiency.

Table 3: variation in NLW ASBVs between the average, bottom 10% and top 10% of ewes using the modified ewe efficiency index (average ewe efficiency over period 2013-2015).

Flock	n	Bottom 10%	Average	Top 10%
Maternal	344	-4.0%	-1.1%	4.1%
White Suffolk	305	-0.9%	3.5%	6.6%

The effect of WWT on ewe efficiency, however is less clear. Whilst brief analysis suggests there is a positive relationship in the Maternal flock (P=0.005) it is not observed in all years, and not significant in the White Suffolk flock (P=0.064). Furthermore, when analysing efficiency in ewes which reared more than one lamb on average, the effect of WWT is insignificant in both breeds.
This is an area that I would like to explore further.

Limitations of the modified ewe efficiency index

There are two main issues with this index: firstly that bias exists in the calculation of SRW, as there are large environmental influences on LW; secondly that the generation of SRW requires data collection over several adult years in order to have increased accuracy.
It would be ideal to have an ASBV for SRW that would account for environmental bias and genetic correlations. I hope, in the future, this may be a possibility.

Ewes which are more resilient to live weight loss during lactation and periods of feed shortage

I am now beginning to work on the identification of more resilient ewes, which includes:
• Those that lose less LW during lactation, whilst maintaining high lamb production
• Those which may lose LW, but respond quickly to supplementary feeding and bounce back cheaply after weaning

Data collection began with ewe LW/CS recorded at weaning in 2015, when ewes were separated into three nutritional groups based on CS. I plan to work this future resilience data into the ewe efficiency index.

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