Final Report

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Impact of percent mature weight on ewe lamb conception

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Abstract

Ewe lamb mating was trialled on 15 properties between 2010 and 2012, involving 4 crossbred flocks and 11 merino flocks. Ewe lambs were joined at weights ranging from 20 to 70 kg and between 7 to 10 months of age, with the resulting conception and weaning percentages recorded. Flocks that participated for more than one year averaged a 60% conception rate in merino ewe lambs and a 75% conception rate in crossbred ewe lambs mated at 7 to 10 months of age. It was found that both the weight and condition score of ewe lambs at joining significantly affected the reproductive rate achieved in both merino and crossbred ewe lambs.

Although the effect of both weight and condition score were significant there was a large variation in the weight range of ewe lambs which conceived. The aim of this project was to determine if percentage mature weight at the time of joining is a better indicator for the likely success of a ewe lamb conceiving than actual joining weight. A strong relationship was found between ewe lamb joining weight and percent mature weight for both merinos (r=0.89) and crossbreds (r=0.88). It was also found that the percentage deviance in reproductive rate of ewe lambs explained by using percentage mature weight was 11.9% for the crossbreeds and 10.2% for merinos, while for joining weight it was 11.4% for the crossbreeds and 9.9% for the merinos. Therefore joining weight still provides a robust approximation of the reproductive rate of ewe lambs.

Executive Summary

Between 2010 and 2012 trials for mating ewe lambs at 7 to 10 months were undertaken on 4 crossbred flocks and 11 merino flocks. The first objective of the PDS was for 60% of merino and 80% of crossbred ewe lambs that are joined at 7-10 months of age to conceive. For the flocks involved in the PDS for more than one year the outcomes in relation to the first objective were;

- a total of 6,904 crossbred ewe lambs were mated of which 5166 conceived, representing a 75% conception rate, and
- a total of 6,980 merino ewe lambs were mated of which 4124 conceived, representing a 59% conception rate.

A key question that PDS participants asked is why some ewes got in lamb and others didn't, particularly those down as low as 30 kg at joining. As a result this project was developed to determine the impact of percent mature weight at joining on the reproductive rate of ewe lambs.

The first objective of this project was measure the mature weight of the ewes that were joined as ewe lambs. To address this objective 10 flocks were revisited in 2014 to determine the mature weight of ewes that were mated as lambs, of which 7 flocks were involved in the original PDS, 2 flocks from WA, and 1 from SA. A total of over 6,000 ewes were assessed for mature weight and condition score on 10 properties. A strong relationship was found between ewe lamb joining weight and percent mature weight for both merinos (r=0.89) and crossbreds (r=0.88).

The next objective was to re-analyse the ewe lamb joining data collected in the original PDS, based on their joining weight as a percentage of mature weight. The aim of this project was to determine if percentage mature weight is a better indicator for the reproductive rate of ewe lambs than actual joining weight. It was found that the percentage deviance in reproductive rate of ewe lambs explained by using percentage mature weight was 11.9% for the crossbreeds and 10.2% for merinos, while for joining weight it was 11.4% for the crossbreeds and 9.9% for the merinos. Therefore joining weight still provides a robust approximation of the reproductive rate of ewe lambs.

The third objective was to develop guidelines for the percentage of mature weight ewe lambs need to reach to join successfully at 7-10 months of age. To optimise the performance of merino and crossbred ewe lambs the target is to have them at 75% of mature weight at joining, resulting in reproductive rates in the order of 90 and 125% respectively (Figure 5). At typical survival rates for merino and crossbred lambs, this results in lamb marking rates of about 65% for merinos and 95% for crossbred ewe lambs, which economic analysis shows would be profitable at current meat prices.

The recommendation is for individual flocks to know the adult weight of their ewes and set a target joining weight for ewe lambs that is 75% of the mature weight. This equates to a 45 kilogram joining weight target for ewes with a mature weight of 60 kilograms, or a 52 kilogram joining weight target for ewes with a mature weight of 70 kilograms.

Background

Meeting current and future demand for sheep-meat, while sustaining a viable national ewe flock, is an ongoing challenge for the Australian sheep industry. Between 1990 and 2010 the breeding ewe flock almost halved (75 million down to 40 million), and then since 2010 has remained stable at around 40 million breeding ewes. Whereas since 2010-11 the number of lambs slaughter annually has risen by almost 25% from 17.9 to 21.9 million. The main way industry is addressing this challenge is delivering a range of programs that are encouraging and educating producers to improve weaning rates, which have risen by about 8% in recent years. Another avenue to increase the total number of lambs weaned is mating more ewes to lamb at 12-15 months of age. With improved management, nutrition and genetics, increased production from ewe lambs would help address the challenge outlined. For instance if ewe lambs were to have an average reproduction rate of 60% this would lift overall number of lambs weaned by 15-20%. Currently, only about 10% of ewes are mated as lambs across the national flock and the limited number of producers that are joining first cross and composite ewe lambs are achieving varied success.

This project follows a successful PDS focused on joining ewe lambs, which highlighted what can be achieved by joining both merino and crossbred ewe lambs. It was found that increasing live weight at joining (7 to 10 months) lifted the total number of lambs scanned (reproductive rate) by 2 to 3% per kg of live weight in crossbred ewe lambs and 3 to 4% per kg of live weight in merino ewe lambs. The PDS not only stimulated significant interest, it also raised several questions in regard to successful ewe lamb joining.

The main query from the PDS related to why some lighter ewe lambs achieved better than expected mating results and some heavy ewe lambs failed to conceive. Participating producers were asking 'are these lighter ewes earlier maturing and hence reached a higher percentage of their mature weight resulting in a successful joining outcome. To answer this question, this project involved revisiting flocks to weigh and condition score ewes that had previously been mated as ewe lambs. This enabled their mature weight to be linked to their joining weight as a lamb, to determine the impact of percent mature weight achieved at joining as a ewe lamb on reproductive rate (number of foetuses scanned per 100 ewes joined).

Project Objectives

1. To establish the mature weight and condition score of trial ewes.

2. To re-analyse the ewe lamb joining data, based on joining weight as a percentage of mature weight.

3. To develop guidelines on the percentage mature weight ewe lambs need to reach to join successfully at 7-10 months of age.

Methodology

The key works undertaken to achieve these objectives include;

- **Weigh and condition score adult ewes joined as ewe lambs in previous trials to determine their mature weight on 10 properties.** The flocks comprised on 7 properties that participated in the BESTWOOL / BESTLAMB PDS that ran between 2010-2012, 2 flocks that were involved in ewe lamb joining trials led by Dr Andrew Thompson in Western Australia and a flock in South Australia that was part of James Whales Sheep CRC funded research into mating ewe lambs.
- **Analyse data to examine relationship between percent mature weight and ewe lamb conception.** Estimates of reproduction (dry, singles and twins) were analysed as a function of flock, joining weight or percentage mature weight using the method of generalised linear model with a multinomial distribution and logit link function. All statistical analyses were performed using GenStat (VSN International 2012). 1.1 Reference: VSN International (2012) GenStat *for Windows* 15th Edition. VSN International, Hemel Hempstead, UK.
- **Report on the findings.** Report to include producer guidelines on the percentage mature weight for ewe lambs to successfully join at 7-10 months and identify the reproductive performance required to profitably join ewe lambs.

Results and discussion

1.1 Objective 1: Mature weight and condition score of trial ewes

A total of 5,592 adult ewes were assessed on 10 properties. The details of the ewes assessed on each property are summarised in Table 1.

Table 1. The number of ewe lambs mated and number of these ewes reassessed as adult ewes for each property.

Flock	Join Year	Breed	Number Joined	Number of adult ewes assessed
McGregor	2010	Merino	252	200
	2011	Merino	350	295
Duxson	2010	Merino		
	2011	Merino	935	145
	2012	Merino	974	200
Kubeil	2012	Merino	444	220
Wall	2011	Merino	268	205
	2012	Merino	389	355
Peddie	2010	X Bred	1641	574
	2011	X Bred	1612	575
Leeming	2011	X Bred	316	230
	2012	X Bred	892	650
Hayes	2010	X Bred	400	38
	2011	X Bred	979	77
	2012	X Bred	614	218
Michael	2011	Merino	400	160
Moojepin	2010	Merino	1100	950
MEF	2010	Merino	1000	500

1.2 Objective 2: Re-analyse the ewe lamb joining data, based on joining weight as a percentage of mature weight

The table below (Table 2) outlines the ewe lamb joining data and adult ewe weight for 7 of the 10 flocks assessed. The Duxson, Michael and MEF flocks were site was excluded from the analysis due to a combination of data missing from joining and possible leverage concerns of the remaining data.

Table 2. The ewe lamb joining data, adult ewe weights and % of adult weight at joining.

Flock	Join Year	Breed	Joining Weight (kg)	Pregnant rate (%)	Reproductive rate (%)	Adult ewe weight (kg)	% of adult weight at joining
McGregor	2010	Merino	43	62	91	69	62.3
	2011	Merino	39	56	68	67.5	57.8
Kubeil	2012	Merino	39	14	17	64	60.9
Wall	2011	Merino	44	78	91	67	65.7
	2012	Merino	44	75	85	64	68.8
Peddie	2010	X Bred	43	80	80	65.7	65.4
	2011	X Bred	45	88	131	65	69.2
Leeming	2011	X Bred	51	81	137	68	75.0
	2012	X Bred	38	49	64	68.5	55.5
Hayes	2010	X Bred	35	42	58	71.8	48.7
	2011	X Bred	40	80	105	69.3	57.7
	2012	X Bred	39	68	81	69.1	56.4
Moojepin	2010	Merino	43	43	55	66.1	65.1

A strong relationship was found between ewe lamb joining weight and percent mature weight for both merinos (r=0.89) and crossbreds (r=0.88). This is depicted in Figures 1 and 2 respectively.

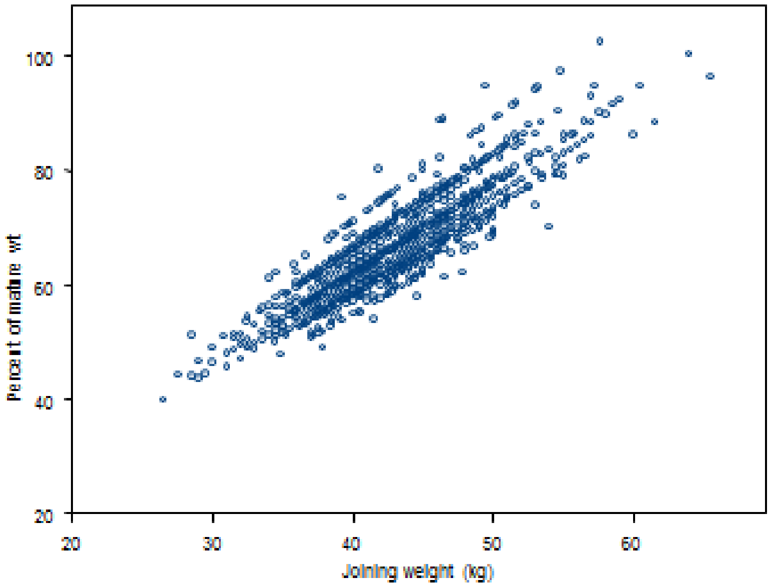

Figure 1. Relationship between joining weight and percent of adult weight for merinos

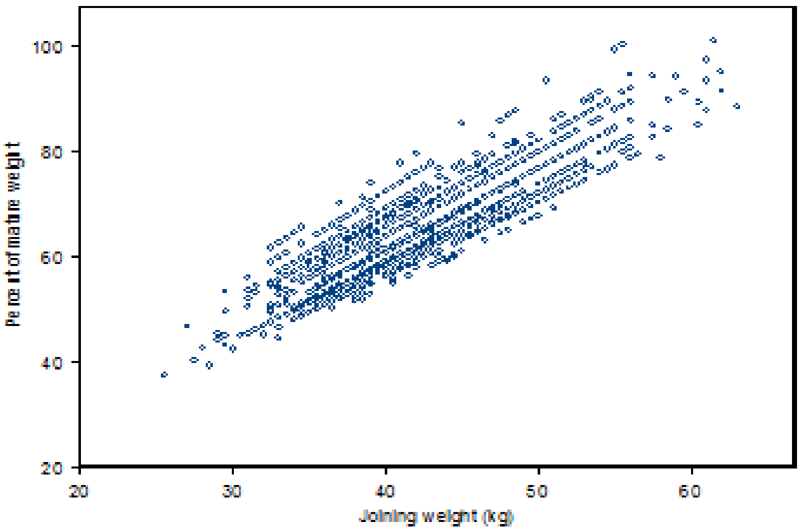

Figure 2. Relationship between joining weight and percent of adult weight for crossbreds

Figures 1 and 2 show that even given adjustment for mature weight the effect at most weights have a similar spread of percentage mature weight. This translates to the similar fit and predictions obtained from the separate analyses. For some idea of comparison of the predictions each kg of liveweight is approximately equivalent to 1.5 % mature weight for both the merino and crossbred sheep (hence values given in the Tables 3 and 4 respectively).

Table 3. The predicted reproductive rate (lambs/100 ewes) for the Merino sites using joining weight, kg, (join wt) or percentage of mature weight (% Mature wt)

Flock	Join wt	Lambs/100 ewes	% Mature wt	Lambs/100 ewes

Kubeil	30	10.3	45	9.5
Kubeil	40	18.5	60	16.8
Kubeil	50	31.3	75	28.3
Kubeil	60	49.1	90	44.6
McGregor	30	56.4	45	58.1
McGregor	40	78.9	60	79.9
McGregor	50	102.4	75	102.7
McGregor	60	125.8	90	125.4
Moojepin	30	29.4	45	26.7
Moojepin	40	46.7	60	42.5
Moojepin	50	68.0	75	62.3
Moojepin	60	91.2	90	84.5
Wall	30	59.0	45	57.7
Wall	40	81.7	60	79.6
Wall	50	105.2	75	102.3
Wall	60	128.6	90	125.0

Table 4. The predicted reproductive rate (lambs/100 ewes) for the Crossbreed sites using joining weight, kg, (join wt) or percentage of mature weight (% Mature wt)

Flock	Join wt	Lambs/100 ewes	% Mature wt	Lambs/100 ewes
Hayes	30	37.1	45	41.1
Hayes	40	78.7	60	84.0
Hayes	50	124.5	75	129.8
Leeming	30	17.4	45	8.1
Leeming	40	81.5	60	41.6
Leeming	50	160.1	75	106.4
Leeming	60	194.8	90	168.0
Peddie	30	115.0	45	107.6
Peddie	40	131.8	60	128.3
Peddie	50	147.7	75	148.0
Peddie	60	161.9	90	165.1

When fitting individual ewes the % deviance were within the bounds of what has been seen in other work (Biometrician observation). What this shows is that although the percentage of mature weight has a slightly better fit overall the joining weight does provide a robust approximation of the reproductive rate.

Table 5. The percent deviance for the relevant models

Merino		Crossbreed	
Model	% deviance	Model	% deviance
Join wt	9.9	Join wt	11.4
% Mature wt	10.2	% Mature wt	11.9

1.3 Objective 3: Guidelines on the percentage mature weight of ewe lambs at joining

A key aspect of developing guidelines for joining ewe lambs is to ensure that the extra production derived doesn't exceed the costs of achieving that production. John Young, Farming Systems Analysis, has undertaken a break even analysis of mating merino ewe lambs using MIDAS (process needs to be repeated for self-replacing crossbred flocks). The MIDAS modelling determined the break even marking percentage required for merino ewe lambs to offset the costs associated with getting the ewe lambs to a joinable weight, at varying lamb prices. The value of an extra lamb outlined in Table 6 at varying lamb prices, is the gross margin value of an extra lamb taking out the extra costs of pregnancy and lactation. While the extra feeding costs, is the cost of feed invested in the ewe lamb over and above a ration that would deliver the widely recommended growth of 1 kg/month in merino weaners.

Breakeven RR rate for first lamb at 12 months of age - Fully stocked **producer**

	Value	Value of	Extra Feeding Cost (above maintenance) ($/hd)						
	$/kg	extra Lmb	10	15	20	25	30	35	40
Lamb Price / Value	$2/kg	15	66%	99%	132%	166%	199%	232%	265%
	$3/kg	27	38%	56%	75%	94%	113%	132%	150%
	$4/kg	39	26%	39%	52%	64%	77%	90%	103%
	$5/kg	54	19%	28%	37%	46%	56%	65%	74%

Table: Breakeven RR rate for first lamb at 12 months of age - Fully stocked producer

In Table 6 the breakeven marking rates at varying lamb prices and feed input costs that are shaded green are considered readily achievable (ie. less than 50% marking rate) based on the results of the previous PDS. The merino flocks that participated in the PDS for more than one year achieved an average marking rate of 50% (3517 lambs from 6980 ewe lambs) to ewes joined. Whereas the marking rates shaded red are not likely to be achieved from ewe lambs (Table 6). The areas shaded yellow and orange are for breakeven marking rates from 56 to 77%, which would require absolute best practice in merino ewe lamb mating and lambing.

Producers commonly have to invest over $20 per head above maintenance feeding to be able to join ewe lambs, which at $4/kg for lamb requires a marking rate of 64% or more to be profitable (Table 6). Hence merino ewe lambs would need to be 75% of mature weight at joining to achieve a reproductive rate of 90% (Figure 3), made up of 20% dry, 15% conceiving twins and 60% singles. At typical survival rates of 60% for twin born lambs and 85% for singles this would result in a marking rate of about 65%.

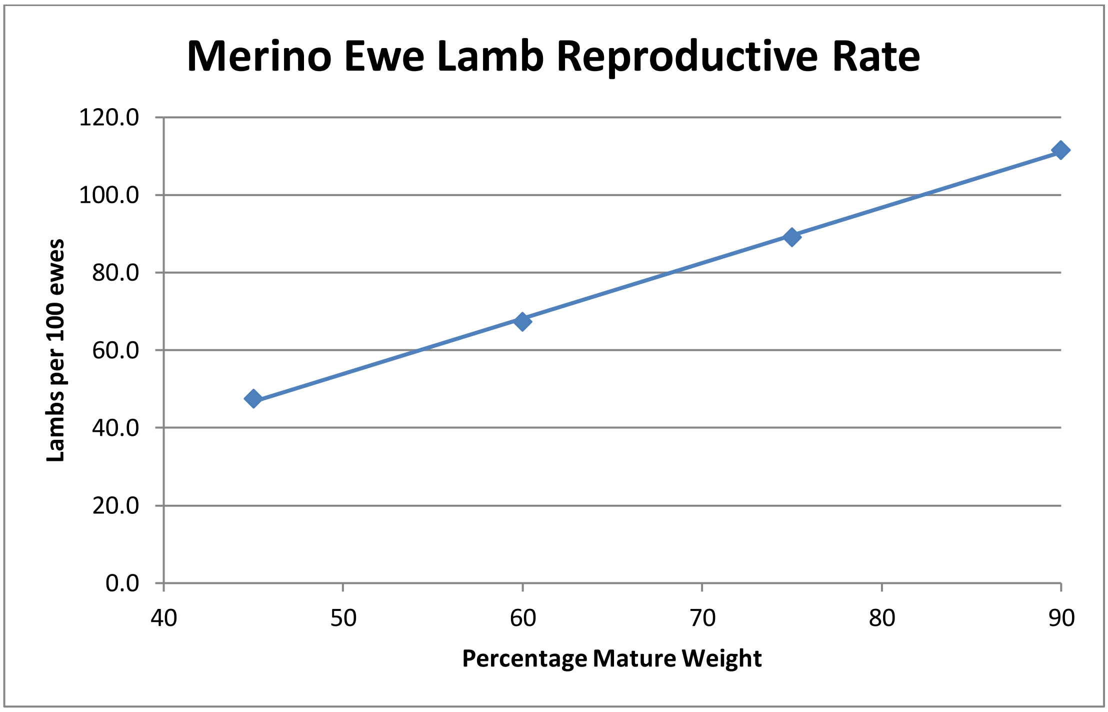

Figure 3. Impact of percent mature weight at joining at 7-10 months on the reproductive rate of merino ewe lambs

MIDAS modelling indicates that for crossbred systems to be equally profitable to merino systems, lamb marking rates need to be at least 30% higher to offset the loss in wool income. Hence, if crossbred ewe lambs were also 75% of mature weight at joining they would achieve a reproductive rate in the order of 125% (Figure 4), made up of 10% dry, 35% conceiving twins and 55% singles. At typical survival rates for crossbred lambs of 65% for twin born lambs and 90% for singles this would result in a marking rate of about 95%, which would achieve similar levels of profitability to a merino system at 65% marking rate. Therefore to optimise performance and profit it is recommended that the target for mating both merino and crossbred ewe lambs is 75% of mature weight.

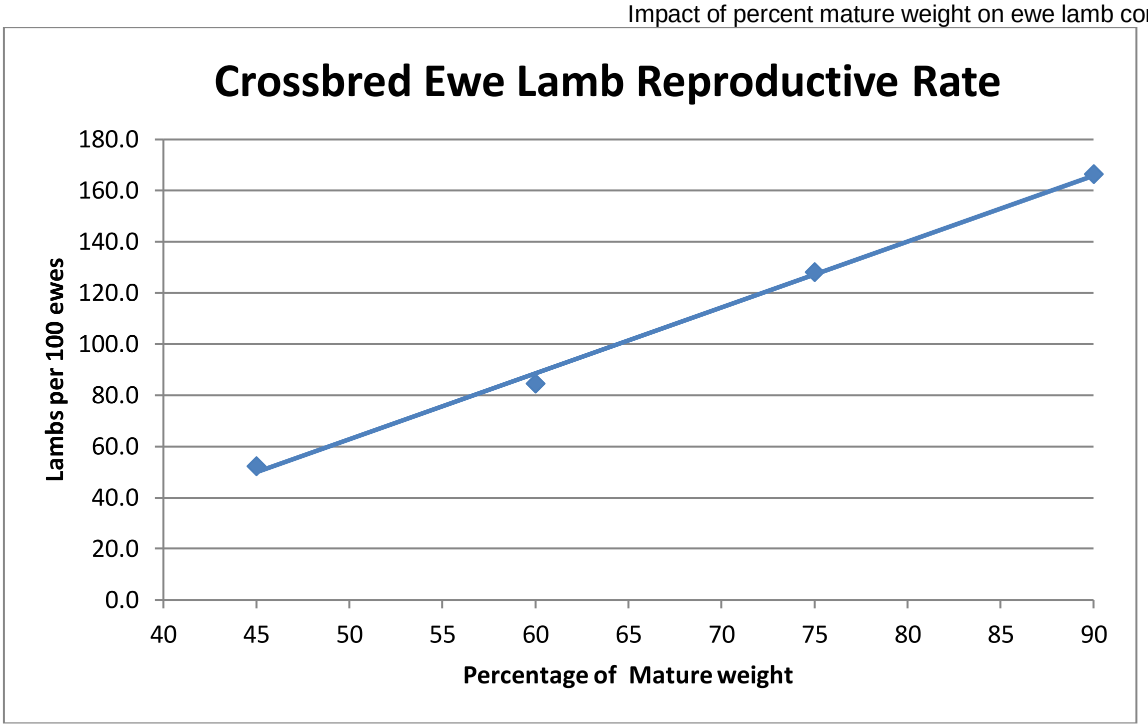

Figure 4. Impact of percent mature weight at joining (7-10 months) on the reproductive rate of crossbred ewe lambs

Communications

The limited budget for this particular component of mating ewe lambs investigations has meant that communications of outcomes has not yet occurred. The original ewe lamb joining PDS generated significant interest from producers within and outside of the participating group. Having producers involved from six different BESTWOOL/BESTLAMB (BWBL) groups has provided an excellent forum for discussion around joining ewe lambs at 7-10 months of age.

A total of 4 field days were held as part of the previous PDS at Ararat, Elmore, St Arnaud and Serpentine with 87 producers attending. Each session discussed the preliminary findings of the PDS and the pros and cons of joining ewe lambs. There was interest from both crossbred and merino breeders in joining ewe lambs. A lot of discussion from crossbred producers in particular focussed around feeding an animal for 18 months with little return if not joined as lambs.

The findings from the original PDS have been promoted at the BWBL annual conference. Also two articles have been published in Feedback Magazine in July 2012 and in January 2013. Feature articles have also been published in both the Stock and Land and the weekly Times, along with an article in the BWBL newsletter. Similar pathways will be used to update information on joining ewe lambs, particularly percent mature weight targets for joining once MLA has approved the findings.

Conclusions

A strong relationship was found between ewe lamb joining weight and percent mature weight for both merinos (r=0.89) and crossbreds (r=0.88). It was also found that the percentage deviance in reproductive rate of ewe lambs explained by using percentage mature weight was 11.9% for the crossbreeds and 10.2% for merinos, while for joining weight it was 11.4% for the crossbreeds and 9.9% for the merinos. Therefore joining weight still provides a robust approximation of the reproductive rate of ewe lambs.

To optimise the performance of merino and crossbred ewe lambs the target is to have them at 75% of mature weight at joining, resulting in reproductive rates in the order of 90 and 125% respectively (Fig. 5). At typical survival rates for merino and crossbred lambs, this results in lamb marking rates of about 65% for merinos and 95% for crossbred ewe lambs, which economic analysis shows would be profitable at current meat prices.

The recommendation is for individual flocks to know the adult weight of their ewes and set a target joining weight for ewe lambs that is 75% of the mature weight. This equates to a 45 kilogram joining weight target for ewes with a mature weight of 60 kilograms, or a 52 kilogram joining weight target for ewes with a mature weight of 70 kilograms.

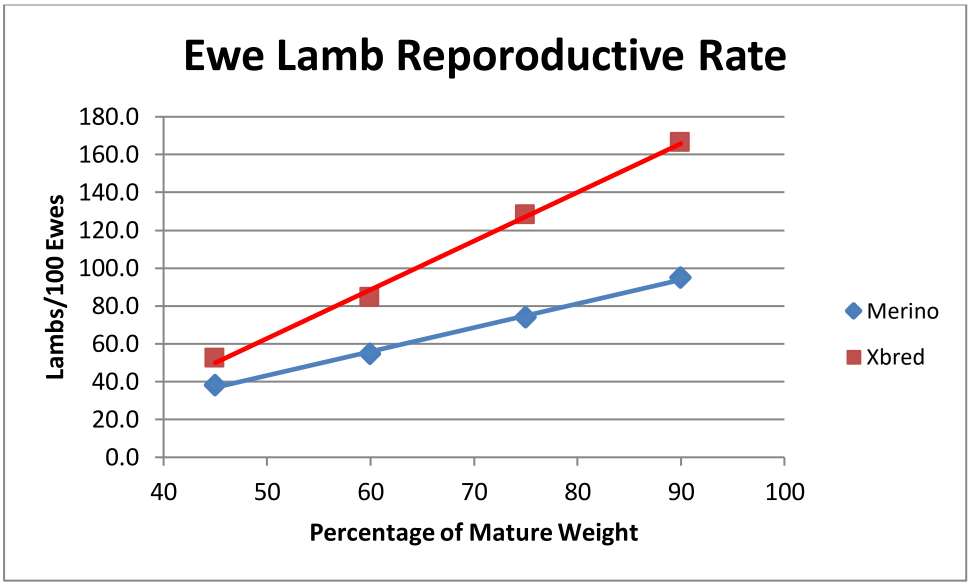

Figure 5. Impact of percent mature weight at joining at 7-10 months on the reproductive rate of merino and crossbred ewe lambs

Acknowledgements

Sincere thanks to all the trial hosts for having a go at mating ewe lambs. Although the results varied all producers involved had the attitude let's trial mating ewe lambs and see what we can learn.

Thank you also to Meat and Livestock Australia for funding the project through the PDS program.

Lastly, this project would not have eventuated without the drive and enthusiasm of members of the BESTWOOL / BESTLAMB network.

Appendix 1: Data Analysis Tables

Flock	join wt	dry	single	twin	lambs/100 ewes
Kubeil	30	0.9063	0.0840	0.0097	10.34
Kubeil	40	0.8338	0.1477	0.0185	18.47
Kubeil	50	0.7223	0.2427	0.0350	31.27
Kubeil	60	0.5742	0.3604	0.0654	49.12
McGregor	30	0.5170	0.4019	0.0811	56.41
McGregor	40	0.3569	0.4977	0.1454	78.85
McGregor	50	0.2234	0.5295	0.2471	102.37
McGregor	60	0.1298	0.4826	0.3876	125.78
Moojepin	30	0.7381	0.2295	0.0324	29.43
Moojepin	40	0.5937	0.3456	0.0607	46.7
Moojepin	50	0.4310	0.4582	0.1108	67.98
Moojepin	60	0.2820	0.5242	0.1938	91.18
Wall	30	0.4971	0.4157	0.0872	59.01
Wall	40	0.3388	0.5056	0.1556	81.68
Wall	50	0.2099	0.5279	0.2622	105.23
Wall	60	0.1211	0.4722	0.4067	128.56

Summary of analysis

Source	d.f.	deviance	mean deviance	deviance ratio
Regression	4	281	70.328	70.33
Residual	1427	2557	1.792	
Total	1431	2838	1.983	

Estimates of parameters

Parameter	estimate	s.e.	t(*)	antilog of estimate
Cut-point 0/1	1.959	0.489	4.01	7.095
Cut-point 1/2	4.319	0.502	8.6	75.15
Flock Kubeil	-2.281	0.203	-11.26	0.1022
Flock McGregor	-0.079	0.161	-0.49	0.9236
Flock Moojepin	-1.048	0.125	-8.41	0.3507
Flock Wall	0			
Join_Wt	0.0657	0.011	5.98	1.068

Flock	Mature %	dry	single	twin	lambs/100 ewes
Kubeil	45	0.9138	0.0774	0.0088	9.5
Kubeil	60	0.8485	0.1350	0.0165	16.8
Kubeil	75	0.7476	0.2217	0.0307	28.31
Kubeil	90	0.6102	0.3333	0.0565	44.63
McGregor	45	0.5038	0.4117	0.0845	58.07
McGregor	60	0.3493	0.5021	0.1486	79.93
McGregor	75	0.2210	0.5308	0.2482	102.72
McGregor	90	0.1305	0.4850	0.3845	125.4
Moojepin	45	0.7616	0.2099	0.0285	26.69
Moojepin	60	0.6280	0.3194	0.0526	42.46
Moojepin	75	0.4716	0.4334	0.0950	62.34
Moojepin	90	0.3206	0.5137	0.1657	84.51
Wall	45	0.5064	0.4099	0.0837	57.73
Wall	60	0.3517	0.5010	0.1473	79.56
Wall	75	0.2229	0.5308	0.2463	102.34
Wall	90	0.1317	0.4863	0.3820	125.03

Summary of analysis

Source	d.f.	deviance	mean deviance	deviance ratio
Regression	4	289	72.142	72.14
Residual	1427	2549	1.786	
Total	1431	2838	1.983	

Estimates of parameters

Parameter	estimate	s.e.	t(*)	antilog of estimate
Cut-point 0/1	1.938	0.442	4.38	6.944
Cut-point 1/2	4.305	0.456	9.43	74.1
Flock Kubeil	-2.335	0.201	-11.61	0.09684
Flock McGregor	0.011	0.162	0.07	1.011
Flock Moojepin	-1.135	0.125	-9.09	0.3213
Flock Wall	0			
percentmat	0.04249	0.00646	6.58	1.043

Unadjusted

Flock	Mature %	dry	single	twin	lambs/100 ewes
Kubeil	50	0.8964	0.0928	0.0108	11.44
Kubeil	65	0.8191	0.1605	0.0204	20.13
Kubeil	75	0.7462	0.2228	0.0310	28.48
Kubeil	90	0.6061	0.3363	0.0576	45.15
McGregor	50	0.4389	0.4537	0.1074	66.85
McGregor	65	0.2905	0.5226	0.1869	89.64
McGregor	75	0.2100	0.5286	0.2614	105.14
McGregor	90	0.1221	0.4745	0.4034	128.13
Moojepin	50	0.7247	0.2408	0.0345	30.98
Moojepin	65	0.5795	0.3566	0.0639	48.44
Moojepin	75	0.4723	0.4326	0.0951	62.28
Moojepin	90	0.3190	0.5137	0.1673	84.83
Wall	50	0.4630	0.4386	0.0984	63.54
Wall	65	0.3109	0.5166	0.1725	86.16
Wall	75	0.2266	0.5304	0.2430	101.64
Wall	90	0.1330	0.4868	0.3802	124.72

Summary of analysis

Source	d.f.	deviance	mean deviance	deviance ratio
Regression	4	286	71.623	71.62
Residual	1427	2551	1.788	
Total	1431	2838	1.983	

Estimates of parameters

Parameter	estimate	s.e.	t(*)	antilog of estimate
Cut-point 0/1	2.01	0.466	4.31	7.462
Cut-point 1/2	4.374	0.48	9.12	79.33
Flock Kubeil	-2.306	0.202	-11.44	0.09968
Flock McGregor	0.097	0.165	0.59	1.102
Flock Moojepin	-1.116	0.125	-8.95	0.3275
Flock Wall	0			
percentmatundj	0.04316	0.00678	6.37	1.044

Flock	join wt	dry	single	twin	lambs/100 ewes
Hayes	30	0.6676	0.2942	0.0382	37.06
Hayes	40	0.3450	0.5234	0.1316	78.66
Hayes	50	0.1214	0.5124	0.3662	124.48
Hayes	60				
Leeming	30	0.8413	0.1439	0.0148	17.35
Leeming	40	0.3262	0.5322	0.1416	81.54
Leeming	50	0.0423	0.3140	0.6437	160.14
Leeming	60	0.0040	0.0441	0.9519	194.79
Peddie	30	0.1542	0.5413	0.3045	115.03
Peddie	40	0.1001	0.4820	0.4179	131.78
Peddie	50	0.0635	0.3958	0.5407	147.72
Peddie	60	0.0397	0.3015	0.6588	161.91

Model for the predictions given in the table (column A - F)

Summary of analysis

Source	d.f.	deviance	mean deviance	deviance ratio
Regression	5	369	73.709	73.71
Residual	1562	2863	1.833	
Total	1567	3232	2.062	

Estimates of parameters

Parameter	estimate	s.e.	t(*)	antilog of estimate
Cut-point 0/1	-0.218	0.484	-0.45	0.8041
Cut-point 1/2	2.31	0.485	4.76	10.07
Flock Hayes	-4.93	1.24	-3.98	0.00722
Flock Leeming	-9.07	1.45	-6.26	0.0001154
Flock Peddie	0	*	*	1
Join_Wt	0.0495	0.0109	4.54	1.051
Join_Wt.Flock Hayes	0.0844	0.0307	2.75	1.088
Join_Wt.Flock Leeming	0.1899	0.0368	5.15	1.209
Join_Wt.Flock Peddie	0	*	*	1

Prediction model with CS at joining included (no predictions have been calculated)

Summary of analysis

Source	d.f.	deviance	mean deviance	deviance ratio
Regression	6	398	66.393	66.39
Residual	1561	2833	1.815	
Total	1567	3232	2.062	

Estimates of parameters

Parameter	estimate	s.e.	t(*)	antilog of estimate
Cut-point 0/1	2.344	0.671	3.49	10.42
Cut-point 1/2	4.906	0.678	7.23	135.1
Flock Hayes	-4.84	1.25	-3.88	0.007888
Flock Leeming	-8.67	1.46	-5.93	0.0001719
Flock Peddie	0	*	*	1
Join_Wt	0.0168	0.0124	1.35	1.017
Join_CS	1.214	0.22	5.52	3.366
Join_Wt.Flock Hayes	0.0862	0.0309	2.79	1.09
Join_Wt.Flock Leeming	0.1837	0.0371	4.95	1.202
Join_Wt.Flock Peddie	0	*	*	1

Flock	percent	dry	single	twin	lambs/100 ewes
Hayes	45	0.6322	0.3242	0.0436	41.14
Hayes	60	0.3091	0.5419	0.1490	83.99
Hayes	75	0.1043	0.4935	0.4022	129.79
Hayes	90				
Leeming	45	0.9249	0.0688	0.0063	8.14
Leeming	60	0.6283	0.3274	0.0443	41.6
Leeming	75	0.1883	0.5592	0.2525	106.42
Leeming	90	0.0308	0.2580	0.7112	168.04
Peddie	45	0.1833	0.5579	0.2588	107.55
Peddie	60	0.1086	0.5000	0.3914	128.28
Peddie	75	0.0620	0.3957	0.5423	148.03
Peddie	90	0.0347	0.2796	0.6857	165.1

Model for the predictions given in the table (column A - F)

Summary of analysis

Source	d.f.	deviance	mean deviance	deviance ratio
Regression	5	386	77.231	77.23
Residual	1562	2845	1.822	
Total	1567	3232	2.062	

Estimates of parameters

Parameter	estimate	s.e.	t(*)	antilog of estimate
Cut-point 0/1	0.338	0.464	0.73	1.402
Cut-point 1/2	2.884	0.467	6.18	17.89
Flock Hayes	-4.24	1.22	-3.48	0.01438
Flock Leeming	-8.13	1.36	-5.96	0.0002939
Flock Peddie	0	*	*	1
percent	0.04072	0.00683	5.96	1.042
percent.Flock Hayes	0.049	0.0207	2.37	1.05
percent.Flock Leeming	0.0917	0.0202	4.54	1.096
percent.Flock Peddie	0	*	*	1

Prediction model with CS at joining included (no predictions have been calculated)

Summary of analysis

Source	d.f.	deviance	mean deviance	deviance ratio
Regression	6	414	68.943	68.94
Residual	1561	2818	1.805	
Total	1567	3232	2.062	

Estimates of parameters

Parameter	estimate	s.e.	t(*)	antilog of estimate
Cut-point 0/1	2.909	0.673	4.32	18.35
Cut-point 1/2	5.488	0.682	8.05	241.9
Flock Hayes	-4.13	1.23	-3.36	0.01616
Flock Leeming	-7.91	1.37	-5.75	0.0003686
Flock Peddie	0	*	*	1
percent	0.02444	0.00748	3.27	1.025
Join_CS	1.114	0.21	5.31	3.045
percent.Flock Hayes	0.0491	0.0208	2.37	1.05
percent.Flock Leeming	0.0929	0.0204	4.56	1.097
percent.Flock Peddie	0	*	*	1