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DIFFERENT MATURE EWE SIZES REQUIRE DIFFERENT STOCKING RATES AND LAMB SLAUGHTER WEIGHTS TO MAXIMISE WHOLE-FARM PROFIT

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SUMMARY

To understand the tradeoff between maintaining a larger ewe and the higher income received from producing larger and faster-growing lambs, we used bio-economic simulation modelling to explore the relationship between ewe mature size, lamb slaughter weight and stocking rate. For the majority of factors tested, ewe feed costs did not reduce gross margin, with the exception of the 80 kg ewe at 14 ewes/ha. Conversely, the 50 kg ewe had higher lamb finishing costs and lower lamb income due to the reduce lamb growth potential, which counteracted the lower ewe feeding costs. Unless enterprises are near the upper limits of stocking rate and mature size tested here, the selection for growth rate in Merinos should continue. To maximise gross margin at each level of mature size, management factors (stocking rate and lamb slaughter weight) were different for each mature size, which influenced income and expense sources differently. When setting breeding objectives and formulating selection indexes the complex interactions between genetic and management factors should be considered.

INTRODUCTION

Mature ewe size is positively correlated with growth rate during immaturity (Borg *et al* 2009; Safari *et al* 2005) and at comparable slaughter weights, lambs from larger ewes will have grown faster, will be younger and have leaner composition than lambs from smaller ewes. However, larger ewes are likely to have a higher maintenance requirement and greater supplementary feed costs than smaller ewes, which could potential reduce farm profit. A tradeoff therefore exists between the costs of maintaining a large ewe and the higher income received from producing larger, faster-growing lambs. This tradeoff is likely to be exacerbated when enterprises increase stocking rate to improve farm profitability, which decreases pasture availability and increases supplementary feeding. In this paper we have used bio-economic simulation modelling to explore the relationship between ewe mature size, lamb slaughter weight and stocking rate. We hypothesise that gross margin decreases as ewe mature size increases due to higher ewe feed costs.

MATERIALS AND METHODS

Using the whole-farm model described below we tested four stocking rates (8, 10, 12, 14 ewes per hectare), four mature sizes (50, 60, 70, 80 kg fleece and conceptus free at condition score 3.0) and three lamb slaughter weights (45, 50, 55 kg live weight). Wool production potential was set at 5 kg greasy fleece weight, 20 micron and 70% yield, and potential reproductive rate was set at 125 lambs per 100 ewes mated. A whole-farm representation of a sheep enterprise in Hamilton, Victoria was constructed using the 'AusFarm' simulation tool (Moore *et al.* 2007). AusFarm is a dynamic

simulation model calculated on a daily time step and uses historical weather information to inform mechanistic models responsible for continuous processes such as soil-water budgets, plant and animal biology. Discontinuous processes such as farm management and interventions are represented, allowing interactions between pasture resources, animal production and farm management.

The enterprise was simulated from 1965 to 2005 using historical weather information. The enterprise is 770 hectares in size, comprising of 19 paddocks and perennial ryegrass and subterranean clover pastures. Merino ewes are mated to Merino rams of the same mature size. Joining is in mid February for a mid July lambing and all non-pregnant ewes except ewe lambs are sold at pregnancy scanning. Ewe lambs are retained as replacements each year and mated at 7 months. Replacement ewe lambs enter the main flock at joining and cast for age (CFA) ewes are sold post-shearing in January. Between lamb marking and weaning, lambs are sold from mothers if they meet the required weight. At weaning any lambs under the required weight are shorn and moved into a feedlot. Weaning occurs when pasture dry matter digestibility declines below 60 percent. Ewes are supplemented from January to July if condition score falls below 2.7. Key financial and production values for this analysis are detailed in table 1. Sheep and lamb sales reference grids for their respective prices (Figure 1). Fleece value was calculated using an analysis of wool price data from 2005 to 2010 for the southwest region of Victoria to generate the equation: fleece weight * (((13.6*micron-627.3)*micron+8011.5) + (-1171+(micron*42.35)) + (-0.876*micron^2) + (staple length*15.3) + (-0.079*staple length^2) + (-0.031*micron*staple length)).

Table 1. Key financial and production assumptions for the whole farm simulation

Feed ($/t)	Fertiliser ($/t)	Shearing ($/hd)	Dressing percentage (%)	Lamb skin price ($/hd)	Drench ($/dose)	Vaccination ($/dose)	Selling costs (%)	Pasture area re-sown (%/year)	Pasture renovation costs ($/ha)
300	500	5.00	46	10	0.30	0.30	5	10	350

a)

	16.0	**18.0**	**22.0**	**26.0**	**30.0**
1.0	1.50	2.00	2.25	2.50	2.50	2.50
2.0	2.50	3.00	3.50	3.50	3.50	3.50
3.0	2.75	3.20	3.50	3.85	3.85	4.00
4.0	2.75	3.20	3.50	3.85	3.85	4.00
5.0	3.00	3.00	3.00	3.00	3.00	3.50
	2.50	2.50	2.50	2.50	2.50	2.50

b)

	24.0	**48.0**	**60.0**	**72.0**	**84.0**
1.0	30	30	30	20	10	10
2.0	40	40	40	20	10	10
3.0	50	50	40	30	30	30
4.0	70	70	70	60	50	40
5.0	80	80	80	70	60	60
	90	90	90	80	70	60

Figure 1. a) The price grid for slaughter lambs ($/kg) with carcass weight (top row) by condition score (left hand column). b) The price grid for cull and non-pregnant ewes ($/head) with age in months (top row) by condition score (left hand column).

RESULTS AND DISCUSSION

Mature ewe size. Although ewe feed costs increased with mature size and stocking rate (Table 2), it only reduced the gross margin in the largest ewes (80 kg) when stocking rate was at its highest level (14 ewes/ha) (Figure 3). On this basis and for the majority of factors tested the hypothesis is not supported, however the analysis does indicate that ewe feeding costs begin to flatten or reduce gross margins when stocking rate is above 12 ewes/ha in the 70 and 80 kg ewes (Figure 3). Lamb slaughter weight exhibited a positive relationship with mature size, but the cause of this relationship was different depending on the ewe size. Smaller ewes were required to slaughter lighter lambs due to limited growth potential, whereas larger ewes sold heavier lambs to maximised lamb income.

Table 2. Mean ewe feeding costs ($/ha) across stocking rate and mature size.

	Stocking rate (ewes/ha)			
Mature size (kg)	8	10	12	14
50	39	55	77	110
60	44	66	100	155
70	51	79	128	209
80	57	95	166	283

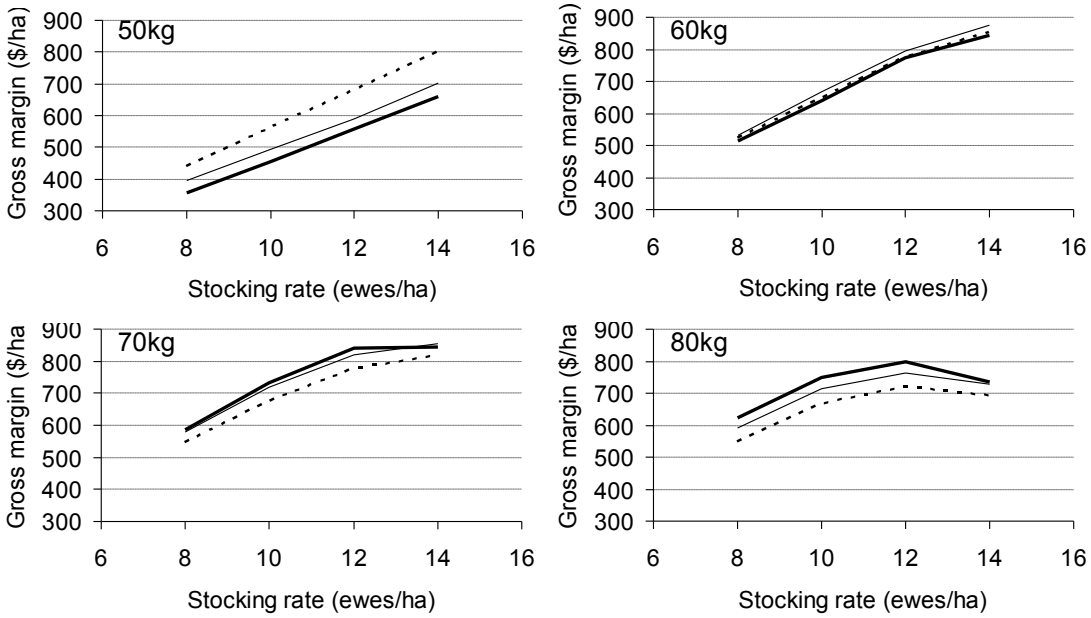

Figure 3. The gross margin values for the interactions between stocking rate, ewe mature size and the lamb slaughter weight (dashed line = 45, thin solid line = 50, thick solid line = 55 kilograms live weight).

Maximising profit for different mature sizes. Gross margin was maximised at each level of mature ewe size with a different combination of stocking rate and lamb slaughter weight (Table 3). Most of these differences are due to a complex set of interactions between genetic (mature size and growth rate) and management factors (stocking rate and lamb slaughter weight). For example, lambs from a 50 kg ewe had lower growth potential, took longer to finish and were slaughter at lighter weight, which increased lamb feeding costs and reduced lamb income, however more lambs were weaned unfinished and shorn before entering the feedlot and therefore lamb wool income increased (Table 3). Conversely, the 80kg had higher ewe feed costs and required stocking rate to be reduced, which reduced all income sources. Generally the 60 and 70 kg mature sizes had a more balanced spread of income sources, but not necessarily the lowest ewe and lamb feeding costs. Depending on where an enterprise is in terms of mature size will determine the importance of different management criteria.

Table 3. The combination of stocking rate and lamb slaughter weight that returned the highest gross margin for each mature size and the respective cost and income sources

Mature size (kg)	Stocking rate (ewes/ha)	Lamb slaughter weight (kg)	Gross margin ($/ha)	Ewe feed costs ($/ha)	Lamb feed costs ($/ha)	Income cull ewes ($/ha)	Income lamb sales ($/ha)	Income ewe wool ($/ha)	Income lamb wool ($/ha)
50	14	45	800	111	82	121	791	456	149
60	14	50	875	157	46	119	926	439	118
70	14	50	855	209	14	118	973	415	80
80	12	55	797	172	16	104	932	345	63

Implications for breeding programs. Unless enterprises are near the upper limits of stocking rate and mature size tested here, and considering the shift towards more lamb income and that most Merinos in the high rainfall zone are likely to be closer to 50 kg than 80 kg, the selection for growth rate should continue and downward pressure on mature size limited. In this analysis we have set wool production potential and reproductive rate at constant levels for each mature size, an extended analysis to include sensitivity of these factors is required given that we could be over and under estimating the contribution of wool and lamb income in the smaller and larger ewes respectively.

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