THE INFLUCENCE OF EWE WEIGHT AT MATING ON LAMB PERFROMANCE AND REPRODUCTION OF THE EWE

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SUMMARY
The condition score and body weight of ewes at mating have well-established effects on reproductive performance and future performance of the progeny in commercial flocks. The aim of this study is to investigate one of these effects, that of ewe weight at mating on ewe reproductive performance and lamb performance in LAMBPLAN flocks (Terminal and Maternal sire breeds). Ewe weight at mating had a significant ($P<0.001$) effect on body weight of the progeny and reproductive traits of the ewe. The effects on lamb body weight ranged from 0.03 kg at birth to 0.18 kg at hogget age per kg of extra ewe weight at mating. The effect of reproductive performance of the ewe was an additional 0.002 lambs born and lambs weaned per additional kilogram of ewe weight at mating. The genetic parameters estimated showed no significant change in the heritabilities of any of the traits investigated with the inclusion of the ewe weight at mating effect.
Keywords: Ewe weight, mating, reproduction, genetic evaluation

INTRODUCTION
In commercial flocks ewe condition score and body weight at mating have been shown to influence reproductive performance and future lamb performance (Kenyon *et al.* 2004; Langford *et al.* 2004; Oldham and Thompson 2004; Paganoni *et al*. 2004). Stud sheep are generally maintained in better condition score and with higher body weights than commercial flocks. The importance of ewe weight at mating has not been quantified in Australian stud sheep. As the LAMBPLAN database facilitates recording of ewe weight at mating by breeders this can now be investigated in more detail. Depending on the magnitude of the effects, adjusting data for the effects of ewe body weight at mating prior to analysis may improve the accuracy of genetic evaluation for these traits.

The aims of this study were to quantify the effect of ewe weight at mating on lamb performance and the reproductive performance of the ewe in Australian stud sheep data and to quantify any potential benefits for the LAMBPLAN genetic evaluation.

MATERIALS AND METHODS
Data were obtained from the LAMBPLAN database, which consists of pedigree and performance records from Australian and New Zealand meat sheep and dual-purpose studs and is used for genetic evaluation purposes. Lamb performance traits extracted were body weight at birth (Bwt), weaning (Wwt), post weaning (Pwt), yearling (Ywt) and hogget (Hwt). Post weaning and yearling fat depth (Pfat and Yfat) and eye muscle depth (Pemd and Yemd) were also available. Reproductive traits of the ewe were number of lambs born (Nlb) and number of lambs weaned (Nlw). The average ages at

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measurements were 103, 198, 357 and 496 days for weaning, post-weaning, yearling and hogget respectively. Only data that met the following criteria were used: 1) date of measurement and current owner recorded, 2) at least sire or dam known, 3) date of birth known, 4) sex identified as male or female, 5) age of dam less than 12 years and 6) a ewe weight (EweWt) at mating record for the dam. To remove possible outliers observations more than 3 standard deviations outside the mean of their contemporaries were deleted. Also contemporary groups (CGs) with fewer than 10 animals were deleted. The pedigree was built using all available ancestors. This resulted in a pedigree of 9,717 animals and records on 3,249 animals. There were 134 sires and 1,782 dams from 12 flocks across 10 years. The number of records with dams also recorded for the lamb traits ranged from 20 to 26% with 95% of dams having sire also recorded.

Table 1. Mean, standard deviation (SD), minimum and maximum for each trait

Trait	Count	Mean	SD	Minimum	Maximum
EweWt (kg)	2,734	77.3	12.7	46.5	121.5
Bwt (kg)	3,249	4.8	1.1	1.0	9.2
Wwt (kg)	2,850	32.8	7.8	11.5	59.0
Pwt (kg)	2,387	49.8	9.5	17.5	84.5
Ywt (kg)	1,372	60.3	13.4	23.8	118.5
Hwt (kg)	795	72.1	16.2	42.8	132.5
Pfat (mm)	1,812	3.5	1.2	0.5	9.0
Yfat (mm)	465	4.3	1.6	1.0	12.0
Pemd (mm)	1,812	30.3	3.9	16.0	40.0
Yemd (mm)	465	30.0	5.0	14.0	43.0
Nlb	2,734	1.6	0.6	1.0	3.0
Nlw	2,553	1.5	0.5	1.0	3.0

Fixed effect analysis was conducted using PROC GLM of SAS (SAS 1990) to examine the phenotypic influences of ewe weight at mating on lamb and ewe traits. Lamb traits were analysed using a model including age, birth type, rearing type, dam age and contemporary group (defined by breed, flock, year, sex and management group). Reproductive traits of the ewe were examined using a repeatability model including the fixed effects dam age and contemporary group (defined by breed, flock and year). Ewe weight expressed as a deviation from the mean ewe weight of 75kg was then added to these models (fitted as a quadratic polynomial) to examine its effect on each trait. Ewe weight class (10 kg classes) least squares means were also estimated. Genetic parameters were then estimated for each trait using an animal model in ASREML (Gilmour *et al.* 2002). The same fixed effect models were used as in the fixed effect analysis described above. The lamb performance traits included direct genetic and maternal genetic effects with the covariance between direct and maternal genetic effects fixed to zero. For the ewe reproductive traits the maternal genetic effect was removed and a repeated record effect added as many ewes had more than one record (up to 6 records per ewe) with an average of 1.5 parities per ewe.

RESULTS AND DISCUSSION

Ewe body weight at mating had a significant influence ($P < 0.001$) on all body weight and reproduction traits (Table 2). There was no significant influence on the carcase traits investigated in this study. The effects on lamb body weight ranged from 0.012 kg at birth to 0.184 kg at hogget per kg of extra ewe weight at mating (Figure 1). That is, a 10kg increase in ewe weight at mating results in approximately 1.84 kg additional weight per lamb at hogget age.

Table 2. Fixed effect solutions and R^2 for ewe weight at mating for lamb and ewe traits

	Bwt	Wwt	Pwt	Ywt	Hwt	Pfat	Yfat	Pemd	Yemd	Nlb	Nlw
Ewe Weight	0.012* (0.002)	0.106* (0.012)	0.117* (0.014)	0.157* (0.019)	0.184* (0.037)	-0.003 (0.003)	0.002 (0.006)	-0.015 (0.007)	-0.010 (0.012)	0.002* (0.001)	0.002* (0.001)
Ewe Weight^2	-0.001* (0.001)	-0.002* (0.001)	-0.002* (0.001)	-0.004* (0.001)	-0.007* (0.001)	0.000 (0.001)	0.000 (0.001)	0.000 (0.001)	0.000 (0.001)	0.0001 (0.001)	-0.0001* (0.001)
R^2 No EweWt	0.46	0.67	0.71	0.83	0.86	0.65	0.68	0.74	0.86	0.109	0.106
R^2 with EweWt	0.47	0.68	0.71	0.84	0.86	0.65	0.68	0.74	0.86	0.110	0.107

* P <0.001

The effect on reproductive performance of the ewe was an additional 0.002 lambs born and lambs weaned per additional kilogram of ewe body weight at mating. The inclusion of this effect only improved the fit of the model by 1% for the body weight and reproductive traits. This is much lower than the 0.03 foetuses per kilogram observed by Oldham and Thompson (2004). A dam age effect (age of the ewe) was also fitted for the reproductive traits. Including dam age explained an additional 1% of the variation in the number of lambs born and weaned but had a larger effect than ewe weight at mating (0.077 and 0.056 lambs per year of dam age respectively). There was a quadratic relationship between ewe weight at mating and ewe age indicating that younger and older ewes are generally lighted in weight at mating compared to mid range age ewes.

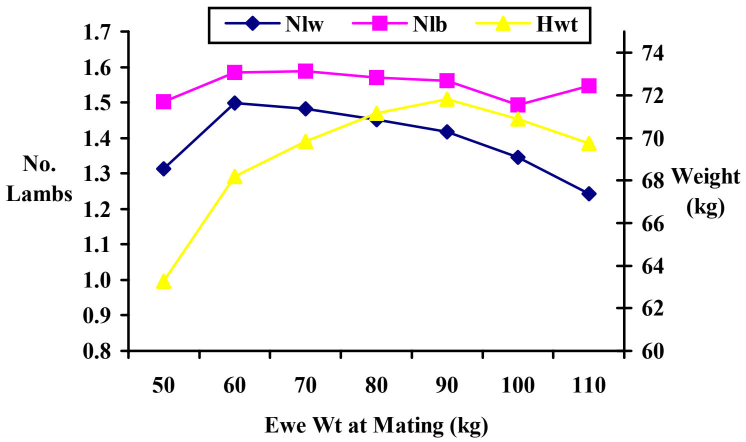

Figure 1. Least squares means for each ewe weight class at mating on ewe reproductive performance (Nlb and Nlw) and hogget weight (Hwt) of the lambs

Table 3. Phenotypic variance (σ^2_p), direct heritability (h^2) and maternal heritability (m^2)

Trait	**Without Ewe Weight**			**With Ewe Weight**		
	σ^2_p	h^2	m^2	σ^2_p	h^2	m^2
Bwt	0.70(0.02)	0.15(0.04)	0.31(0.03)	0.69(0.02)	0.15(0.04)	0.30(0.03)
Wwt	21.12(0.69)	0.18(0.05)	0.11(0.03)	20.36(0.65)	0.17(0.05)	0.09(0.03)
Pwt	27.69(0.99)	0.24(0.06)	0.08(0.03)	26.68(0.93)	0.21(0.05)	0.08(0.03)
Ywt	29.22(1.30)	0.26(0.08)	0.00(0.04)	27.58(1.19)	0.23(0.07)	0.00(0.00)
Hwt	37.12(2.30)	0.40(0.10)	0.00(0.00)	36.21(2.25)	0.38(0.12)	0.00(0.05)
Pfat	0.49(0.02)	0.19(0.06)	NF	0.49(0.02)	0.19(0.06)	NF
Yfat	0.81(0.06)	0.20(0.12)	NF	0.81(0.06)	0.20(0.12)	NF
Pemd	3.95(0.18)	0.44(0.07)	NF	3.94(0.17)	0.43(0.07)	NF
Yemd	3.52(0.26)	0.18(0.11)	NF	3.51(0.26)	0.18(0.11)	NF
Nlb	0.33(0.01)	0.10(0.03)	NF	0.33(0.01)	0.11(0.03)	NF
Nlw	0.26(0.01)	0.07(0.02)	NF	0.26(0.01)	0.08(0.03)	NF

NF = Not fitted in model

The genetic parameters estimated showed no significant change in the heritabilities of any of the traits investigated with the inclusion of the ewe weight at mating effect (Table 3). The trend for the body weight traits was actually to decrease the heritability. This is a result of the genetic correlation between body weight of the ewe and her progeny.

CONCLUSIONS

While the condition score and body weights of ewes at mating have well-established effects in commercial flocks, ewe body weight at mating did not have a large effect on the performance traits recorded in stud flocks by LAMBPLAN. This is possibly due to the higher level of nutrition and management generally observed in seed stock flocks. The inclusion of the ewe weight at mating effect produced no significant change in the heritability of any of the traits investigated. Based on these results it is concluded that the current EBVs produced by LAMBPLAN are not adversely affected by not including adjustments for ewe body weight at mating.

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