

## **GENETIC PARAMETERS FOR ULTRASOUND SCAN AND WOOL TRAITS AT YEARLING AND HOGGET AGE IN MERINO SHEEP**

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### **SUMMARY**

The Australian Merino is the most important genetic resource for the wool and the lamb and sheep meat industries of Australia. In this paper estimated genetic parameters for ultrasound scan and wool traits at yearling and hogget age are presented for Merino sheep. Results indicate that it is possible to breed Merino sheep that perform well for both ultrasound scan and wool characteristics when both are measured.

**Keywords:** Merino, body weight, ultrasound scan, wool, genetic correlation

### **INTRODUCTION**

The Australian Merino is the most important genetic resource for the wool and the lamb and sheep meat (mutton) industries of Australia. More importantly the contribution of wool and meat to the profitability of the Merino flocks is changing, as currently more value is being placed on carcase and reproductive characteristics. Even in traditionally fine wool growing regions in Australia the value of mutton has put extra pressure on the prices that are paid for replacement sheep and on the mix of wethers to ewes. From a total population of 47 million merino ewes approximately 45% are joined to terminal sires for prime lamb production (Connell and Hooper, 2001). In contrast to the numerous scientific studies aimed at understanding the genetics of wool traits in Merinos, there are very few studies that provide accurate information on the relationships between wool and non-wool traits. Specifically, there is a lack of information on the relationships between carcase and wool traits in Merinos. This paper reports results from an investigation into the relationships between carcase and wool traits.

### **MATERIAL AND METHODS**

**Data.** Pedigree and performance data were extracted from the Merino Genetic Services database. This database consists of pedigree and performance records from Australian and New Zealand Merino studs and is used for genetic evaluation purposes. The database currently holds records on over 500,000 animals. Data for body weight (wt), scanned fat depth (fat), scanned eye muscle depth (emd), greasy fleece weight (gfw), clean fleece weight (cfw), fibre diameter (fd), fibre diameter coefficient of variation (fdcv), staple length (sl), staple strength (ss), and mean fibre curvature (curve), all recorded at yearling and hogget age, were extracted. Only data that met the following criteria were used: 1) date of measurement and current owner were recorded, 2) at least sire or dam was known, 3) date of birth was known, 4) animal was born in or after 1999, 5) the sex was identified as male or female, 6) pure-bred Merino or Poll Merino, and 7) age of dam was less than or equal to 12 years. Observations more than 3 standard deviations outside the mean of their contemporaries were also deleted, and all observations in contemporary groups smaller than 10 animals were

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removed. The pedigree was built using all available ancestors.

**Analysis.** The appropriate models for analysis were determined by Huisman *et al.* (unpublished). A maternal genetic effect was included for body weight, greasy and clean fleece weight; fibre diameter, and fibre diameter coefficient of variation at yearling and hogget age. The fixed effect models were also determined by Huisman *et al.* (unpublished) and depended on the trait of interest, for all traits contemporary group was fitted. For body weights, greasy and clean fleece weights, fibre diameters, and fibre diameter coefficient of variation age of animal, a quadratic polynomial on dam age, birth and rear type were fitted. For fat and eye muscle depth a quadratic polynomial on weight was fitted. For staple strength and staple length only age of animal was fitted, and for mean fibre curvature only dam age was fitted. All correlations were estimated in bivariate models that were fitted using the ASREML program (Gilmour *et al.* 2002) and an animal model. Correlations were considered significant when they were significantly different from zero using a 5% significance level.

**Table 1. Descriptive statistics of yearling (Y) and hogget (H) traits**

Trait	Records	Mean	SD	units	% known dam	% dam with record
Ywt	61,917	43.1	12.8	kg	42.5	5.4
Hwt	53,689	51.0	13.9	kg	43.3	10.4
Yfat	30,416	2.4	0.9	mm	44.3	3.5
Hfat	24,648	2.8	1.0	mm	42.1	4.2
Yemd	30,444	23.1	4.5	mm	44.4	3.3
Hemd	24,819	24.3	4.3	mm	42.2	4.2
Ygfw	31,867	3.3	1.2	kg	48.9	3.8
Hgfw	30,745	4.4	1.1	kg	57.8	12.5
Ycfw	32,984	2.3	0.8	kg	50.7	4.6
Hcfw	30,127	3.0	0.8	kg	57.5	12.4
Yfd	72,026	17.1	1.8	micron	49.7	12.1
Hfd	59,790	18.5	1.9	micron	52.4	15.7
Yfdcv	69,875	19.7	2.9	%	50.4	12.2
Hfdcv	59,077	19.9	3.0	%	52.4	15.8
Ysl	14,321	75.2	16.0	mm	48.1	2.1
Hsl	17,683	88.0	17.4	mm	53.1	16.0
Yss	4,079	28.1	12.3	N/Ktex	40.6	0.0
Hss	7,993	31.2	12.5	N/Ktex	52.4	15.9
Ycurv	41,937	90.4	14.6	degrees/mm	45.7	5.6
Hcurv	31,851	89.2	14.9	degrees/mm	54.0	11.4

## RESULTS AND DISCUSSION

Most data was available for wt and fd traits (Table 1). Approximately 50% of the animals had a known dam, while the percentage of dam with own record varied from 0.0% for Yss to 16.0% for Hsl.

In general, the correlations between fat depth and fleece weight are negative, which indicates that

### *Genetic Parameters in Merino Sheep*

sheep with a heavier fleece have less fat than animals that have a lighter fleece. The genetic correlation between eye muscle depth and fleece weight is similar to the genetic correlation between fat depth and fleece weight, although somewhat less negative. Lee *et al.* (2002) reported negative genetic correlations between fat and cfw, -0.29 at 12 months, and -0.16 at 27 months. Fibre diameter has a small positive correlation with both fat and emd, while fdcv has a small negative correlation with both fat and emd (Table 2). Lee *et al.* (2002) reported a positive genetic correlation between fat and fd of 1.14 at 12 months and 0.37 at 28 months. Both sl and ss have a small positive genetic correlation with fat and emd (Table 2). The genetic correlations between ss and ultrasound scan traits (0.10 to 0.41) are somewhat higher than the genetic correlation between sl and ultrasound scan traits (0.03 to 0.20). The genetic correlation between emd and ss indicates that ss would not deteriorate when selection is aimed at improved emd. Mean fibre curvature is not related to either ultrasound scan or growth (Table 2), which indicates that we can improve ultrasound scan and growth traits without affecting curvature, which is an indicator of crimp frequency and therefore style (Brown *et al.* 1999). Most correlations between ultrasound scan and wool traits were not significantly different for yearling and hogget traits, except for the correlation between fat and fdcv, and the correlation between emd and fdcv.

Body weight and fleece weight have a low to moderate positive genetic correlation (0.21-0.38) (Table 2). The genetic correlations between wt and cfw were lower than the genetic correlations between wt and gfw, although not significantly different. Lewer *et al.* (1994) and Wuliji *et al.* (2001) reported small positive genetic correlations between gfw at 14 months and a range of body weights, and gfw at 10 months and a range of body weights, respectively. In both studies the estimates were slightly lower than the estimates presented in this study. Lewer *et al.* (1994) also found that cfw is somewhat less correlated to body weight than greasy fleece weight. The genetic correlation between wt and fd was approximately 0.20 (Table 2). Greeff and Karlsson (1998) report a low genetic correlation (0.06) between fd and wt measured at hogget age. Lewer *et al.* (1994) reported higher genetic correlations between fd and wt (range: 0.29-0.69), but only in males, in females the genetic correlation between fd and wt was approximately zero. Fibre diameter coefficient of variation has a negative genetic correlation with wt; however estimates presented in Table 2 are not significantly different from zero. Other studies that reported on the relationship between wt and fdcv are Greeff and Karlsson (1998), -0.01 at 15 months, and Brown *et al.* (2002), -0.24 at yearling age and -0.21 at hogget age. Staple length, ss and curv do not have strong genetic relationships with wt (Table 2); all estimated correlations between sl, ss, curv, and wt are not significantly different from zero, except for Ysl and wt. Greeff and Karlsson (1998) reported a zero genetic correlation between wt and sl, while Purvis and Swan (1997) reported a small positive genetic correlation (0.12) between wt and sl at nine months. Small negative estimates between wt and ss were reported by Greeff and Karlsson (1998), -0.12 at 15 months and -0.10 at 16 months. The genetic correlation between wt and curv was not significantly different from zero (Table 2), which was also found by Brown *et al.* (2002). Most correlations between body weight and wool traits were not significantly different for yearling and hogget traits, except for the correlation between wt and sl.

### **CONCLUSIONS**

Eye muscle depth has small undesirable correlations with both fleece weight and fibre diameter, and

desirable correlations with fibre diameter coefficient of variation, staple length and strength. Body weight has small undesirable correlations with fibre diameter. However, genetic correlations between ultrasound scan and wool traits are moderate to low, which makes the combined selection for improved wool and ultrasound scan characteristics possible. When both are measured genetic progress can be made in wool and ultrasound scan characteristics simultaneously.

**Table 2. Genetic correlations between ultrasound scan and wool traits (standard errors as subscripts)**

	Ywt	Hwt	Yfat	Hfat	Yemd	Hemd
Ygfw	0.32 <sub>0.05</sub>	0.27 <sub>0.06</sub>	-0.13 <sub>0.08</sub>	0.07 <sub>0.10</sub>	-0.15 <sub>0.07</sub>	-0.02 <sub>0.08</sub>
Hgfw	0.32 <sub>0.05</sub>	0.38 <sub>0.04</sub>	-0.15 <sub>0.08</sub>	-0.29 <sub>0.07</sub>	-0.12 <sub>0.07</sub>	-0.16 <sub>0.06</sub>
Ycfw	0.29 <sub>0.05</sub>	0.21 <sub>0.06</sub>	-0.10 <sub>0.09</sub>	0.04 <sub>0.10</sub>	-0.13 <sub>0.08</sub>	-0.02 <sub>0.08</sub>
Hcfw	0.28 <sub>0.05</sub>	0.35 <sub>0.04</sub>	-0.09 <sub>0.08</sub>	-0.27 <sub>0.07</sub>	-0.06 <sub>0.07</sub>	-0.11 <sub>0.06</sub>
Yfd	0.23 <sub>0.03</sub>	not converged	0.15 <sub>0.06</sub>	0.05 <sub>0.07</sub>	0.15 <sub>0.05</sub>	0.03 <sub>0.06</sub>
Hfd	0.17 <sub>0.04</sub>	0.21 <sub>0.03</sub>	0.13 <sub>0.06</sub>	0.02 <sub>0.06</sub>	0.11 <sub>0.05</sub>	0.11 <sub>0.05</sub>
Yfdcv	-0.10 <sub>0.04</sub>	-0.06 <sub>0.05</sub>	-0.04 <sub>0.07</sub>	-0.29 <sub>0.08</sub>	-0.07 <sub>0.06</sub>	-0.09 <sub>0.07</sub>
Hfdcv	-0.06 <sub>0.05</sub>	-0.02 <sub>0.04</sub>	-0.13 <sub>0.07</sub>	-0.25 <sub>0.06</sub>	-0.18 <sub>0.06</sub>	-0.22 <sub>0.05</sub>
Ysl	0.33 <sub>0.06</sub>	0.20 <sub>0.07</sub>	0.03 <sub>0.10</sub>	0.20 <sub>0.11</sub>	0.06 <sub>0.09</sub>	0.11 <sub>0.09</sub>
Hsl	0.06 <sub>0.07</sub>	0.01 <sub>0.05</sub>	0.12 <sub>0.08</sub>	0.17 <sub>0.07</sub>	0.07 <sub>0.07</sub>	0.11 <sub>0.06</sub>
Yss	0.20 <sub>0.12</sub>	-0.14 <sub>0.14</sub>	0.10 <sub>0.16</sub>	0.41 <sub>0.19</sub>	0.28 <sub>0.15</sub>	0.12 <sub>0.16</sub>
Hss	0.06 <sub>0.09</sub>	0.06 <sub>0.07</sub>	0.22 <sub>0.10</sub>	0.20 <sub>0.08</sub>	0.16 <sub>0.09</sub>	0.19 <sub>0.07</sub>
Ycurv	0.01 <sub>0.04</sub>	-0.02 <sub>0.05</sub>	0.11 <sub>0.07</sub>	-0.03 <sub>0.08</sub>	0.00 <sub>0.06</sub>	-0.05 <sub>0.06</sub>
Hcurv	0.07 <sub>0.05</sub>	0.03 <sub>0.04</sub>	0.05 <sub>0.07</sub>	0.12 <sub>0.07</sub>	-0.03 <sub>0.06</sub>	0.07 <sub>0.05</sub>

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