THE VALUE OF BIRTHCOAT SCORE AS AN EARLY AGE SELECTION CRITERION FOR SUPERFINE MERINO SHEEP

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SUMMARY
Data from the CSIRO Fine Wool Project flock were used to examine the relationships between birthcoat, economically important fleece traits and body weight. Birthcoat was found to be highly heritable, and had small positive genetic correlations with coefficient of variation of fibre diameter (0.24), staple length (0.25) and mean fibre diameter (0.12). Genetic correlations between birthcoat and clean fleece weight, staple strength, mean fibre curvature, birth weight and hogget body weight were essentially zero. Correlation estimates were used to model the effects of selection strategies incorporating birthcoat on a breeding objective aimed at increasing clean fleece weight, reducing mean fibre diameter and maintaining staple strength. Birthcoat did not increase economic gains when included in the selection criteria.
Keywords: birthcoat, Merino, fleece characteristics, selection

INTRODUCTION
The birthcoat establishes from pre-natal fibre growth of primary and a proportion of secondary wool follicles. It can range from fine, with fine fibres and short tight curls, to coarse, where long, coarse, protruding halo hairs dominate (Fraser and Short 1960). After birth the remaining secondary follicles mature and the birthcoat is 'replaced' by the hogget fleece (Ponzoni *et al.* 1997). In the past there has been conjecture that birthcoat type is associated with economically important fleece traits such as variation in fibre diameter and age related changes in mean fibre diameter.

Studies of birthcoat in Australia have concentrated on the South Australian Merino strain. Schinckel (1955) and Ponzoni *et al.* (1997) reported high heritability estimates for birthcoat in the order of 0.65 – 0.70. Schinckel (1958) and Ponzoni *et al.* (1997) showed that birthcoat has moderate negative genetic correlations with crimp frequency (cf) and positive correlations with coefficient of variation of fibre diameter (cvd). Despite high heritability estimates and low to moderate genetic correlations with some fleece traits, Ponzoni *et al*. (1997) concluded that the value of including birthcoat as an early age selection criteria was limited in South Australian Merinos.

The objective of this study was to estimate the heritability of birthcoat and genetic correlations between birthcoat and hogget fleece characteristics in fine and superfine wool Merinos. Subsequently, the effectiveness of birthcoat as an early age selection criterion for economically important fleece traits was assessed in fine and superfine Merinos.

MATERIALS AND METHODS

Animals. Data were collected from 9,307 lambs born into the CSIRO Fine Wool Project (FWP) flock from 1990 to 1997 inclusive. The FWP flock represented 11 industry bloodlines (9 fine and superfine and 2 medium wool bloodlines), the flock structure and management details of which are reported in Swan *et al.* (2001).

Birthcoat score (bsc) was determined from a photographic standard at the mid backline position within 24 hrs of birth. Scores ranged from 1 (no halo hairs) to 7 (abundance of halo hairs). Hogget (10 mo) fleece characters examined were greasy fleece weight (gfw), clean fleece weight (cfw), mean fibre diameter (mfd), coefficient of variation in fibre diameter (cvd), staple length (sl), staple strength (ss) and mean fibre curvature (mfc). Animals were weighed at birth (bwt) and as hoggets (hwt).

Statistical Methods. The data were analysed using the statistical package ASREML (Gilmour *et al.* 2001). Fixed effects tested for significance were bloodline, age of dam, combined birth-rearing type, sex, management flock and age at hogget shearing (fitted as a covariate). All of these except birth-rearing type had significant effects on birthcoat. These fixed effects were included in a univariate mixed model that included random animal and maternal components. The resulting variance components were used as starting values for bivariate analyses from which the heritability of birthcoat and phenotypic and genetic correlations among birthcoat and the fleece and body weight traits were estimated.

Response to Selection. Response to selection over 10 years was estimated using SELIND (Cunningham and Mahon 1974). The breeding objective was to increase cfw and decrease mfd while maintaining ss. Three selection strategies were tested, selection on i) bcs only, ii) cfw, mfd and cvd and iii) cfw, mfd, cvd and bcs. The heritability and correlation estimates for birthcoat from this study were combined with estimates of the fleece and body weight correlations made previously from the FWP (Swan, A.A. unpublished data) to form the input matrix for SELIND. Two micron premium (MP) indices were tested, firstly where the MP was 8% (with ss premium of 2%) and secondly where the MP was 20% (with ss premium of 4%). The generation interval was assumed to be 2.5 years for males and 4 years for females, with 6% of males and 50% of females retained as replacements. The relative economic values (REVs) were: cfw = 12.27, $mfd_{8\%}$ = -1.26, $mfd_{20\%}$ = -3.15, $ss_{2\%}$ = 0.31, $ss_{4\%}$ = 0.63 and hwt = 0.30.

RESULTS

Phenotypic and genetic parameter estimates. Table 1 shows phenotypic (r_p) and genetic (r_g) correlation estimates for bcs with the economically important fleece and body weight traits. The mean bcs was 4.04 and the phenotypic variance (V_p) was 2.00. The heritability of birthcoat in fine wool sheep was estimated to be 0.65 (0.02). Phenotypic and genetic correlations between birthcoat and all fleece and bodyweight traits examined were low to negligible.

Table 1. Estimates of phenotypic (r_p) and genetic (r_g) correlations between birthcoat and economically important fleece and bodyweight traits

	gfw	cfw	mfd	cvd	sl	ss	mfc	bwt	hwt
r_p	0.07	0.06	0.08	0.15	0.14	-0.04	-0.03	0.05	0.01
r_g	0.07	0.05	0.12	0.24	0.25	-0.04	-0.04	0.05	-0.03

Standard errors for phenotypic correlations <0.02, and for genetic correlations 0.03 – 0.08

Response to Selection. Table 2 shows predicted response to selection over 10 years under the three selection scenarios. Selection on bcs alone could be expected to result in a substantial decrease (-3.96) in bcs. These changes are predicted to be accompanied by relatively small, but favourable changes in mfd, cvd, ss and hwt, and small adverse effects on cfw and sl.

The addition of bcs to the selection criteria does not increase the genetic gains over the 'standard' set of selection criteria (cfw, mfd and cvd).

Table 2. Predicted response (expressed as deviation from the mean) for two micron premium (MP) indicies in birthcoat score (bcs), hogget body weight (hwt) and economically important fleece traits after 10 years of selection where the breeding objective ($Obj) was to increase clean fleece weight (cfw) and decrease mean fibre diameter (mfd) while maintaining staple strength (ss)

			Predicted response per 10 years of selection							
Selection criteria	MP	$ Obj	gfw (kg)	cfw (kg)	mfd (μm)	cvd (%)	sl (mm)	ss (N/ktex)	hwt (kg)	bcs
bcs	1	0.45	-0.05	-0.03	-0.36	-1.22	-5.23	0.78	0.21	-3.96
	2	1.37	-0.05	-0.03	-0.36	-1.22	-5.23	0.78	0.21	-3.96
cfw+mfd	1	6.09	0.35	0.33	-0.68	-0.98	5.10	2.22	1.53	-0.32
+cvd	2	9.11	0.18	0.21	-1.72	-1.33	3.04	1.48	0.72	-0.64
cfw+mfd	1	6.09	0.35	0.33	-0.69	-1.01	4.85	2.21	1.53	-0.51
+cvd+bcs	2	9.12	0.18	0.21	-1.72	-1.37	2.74	1.47	0.73	-0.87

MP 1 (mfd premium 8%, ss premium 2%), MP 2 (mfd premium 20%, ss premium 4%)

DISCUSSION

The heritability estimate for birthcoat of fine wool Merinos was in agreement with those of Schinkel (1955) and Ponzoni *et al.* (1997) for a South Australian Merino strain. However, genetic correlations between birthcoat and fleece traits were found to be weaker (and for some traits almost zero) in the FWP compared to those found by Schickel (1958) and Ponzoni *et al.* (1997). The largest discrepancy between the studies occurs in the genetic correlations found by Ponzoni *et al.* (1997) between bcs and cf (-0.38) and the genetic correlations found in this study between bcs and mfc (-0.03). Smith (2003), in a subset of animals from the FWP, found similar correlations for cf and mfc with other fleece traits. Hence, these differences between the findings of Ponzoni *et al.* (1997) and the current study may be indicative of strain differences and further evidence that genetic relationships found within one strain of Merino should not be applied to other strains for genetic evaluation purposes.

Direct selection on fleece traits remains the most efficient method of achieving current industry standard breeding objectives. As a consequence of continued direct selection there will be a gradual reduction in bcs among Superfine Merinos. Significant genetic correlations between birthcoat grade and cold resistance (0.56) have been reported in Medium Merino lambs (Slee *et al.* 1991), although Ponzoni *et al* (1997) found no correlations between birthcoat grade and lamb survival in South Australian Merinos. Investigation into this potential relationship in Superfine Merinos is recommended as the impact of continued reduction in bcs on lamb survival in severe weather conditions could be potentially devastating.

ACKNOWLEDGMENTS

K.E. Kemper acknowledges CSIRO Livestock Industries for providing the summer studentship to conduct this research and the support of staff at the FD McMaster Laboratory Chiswick.

REFERENCES

Cunningham, E.P. and Mahon, G.A.T. (1974) "SELIND User's Guide". pp 1-7.

Gilmore, A.R., Cullis, B.R., Welham, S.J. and Thompson R. (2001) "ASREML Reference Manual", NSW Agriculture, Orange.

Fraser, A.S. and Short, B.F. (1960) "Biology of the fleece", p. 19. Animal Research Technical Paper No. 3, CSIRO, Melborne.

Ponzoni, R.W., Grimson, R.J., Jaensch, K.S., Smith, D.H. and Hynd, P.I. (1997) *Wool Tech. Sheep Breed.* **45:** 12.

Schinckel, P.G. (1955) *Aust. J. Agric. Res.* **6:** 595.

Schinckel, P.G. (1958) *Aust. J. Agric. Res.* **9:** 567.

Slee, J., Alexander, G., Bradley, L.R., Jackson, N. and Stevens, D. (1991) *Aust. J. Expt. Agric.* **31**: 175.

Smith, J.L. (2003) PhD Thesis, p. 123. University of New England. (submitted).

Swan, A.A., Purvis, I.W., Piper, L.R., Lamb, P.R. and Robinson, G.A. (2000) In 'Finewool 2000: Breeding for Customer Needs', p65. Eds. A.A. Swan and L.R. Piper, CSIRO and The Woolmark Company.