GENETIC PARAMETERS FOR REPRODUCTION AND FLEECE TRAITS FOR SOUTH AUSTRALIAN MERINO SHEEP

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INTRODUCTION

A considerable amount of selection takes place among Merino sheep well before the expression of ewe reproduction. Most of the emphasis is placed upon wool traits, followed by body traits. With few exceptions, reproductive traits receive a lesser amount of attention (Casey and Hygate, 1992). The wool traits that are normally the focus of genetic improvement programs are clean fleece weight (CFW) and fibre diameter (FD). When reproductive rate is part of the breeding objective information on the genetic correlation between wool and reproductive traits is required for the calculation of relevant selection indices. Furthermore, even when it is not in the breeding objective, it is important in order to predict correlated responses in reproductive rate when clean fleece weight and fibre diameter are the only traits selected for. In this paper we report the phenotypic and genetic correlations of CFW and FD with number of lambs weaned per ewe joined (NLW) for South Australian Merino sheep. Earlier studies have reported heritabilities for reproduction and wool traits (Ingham and Ponzoni, 2000 ; Hill, 2001).

MATERIALS AND METHODS

The data used were from the Turretfield Merino Resource Flock (Ponzoni *et al*., 1995). In ewes NLW was recorded at 28, 40, 52 and 64 months of age, as were CFW and FD, with an earlier measurement at 16 months, from 1991 to 1997. Ram CFW and FD records were recorded at 10 and 16 months of age, from 1989 to 1993. Table 1 shows the number of records available, the mean and the standard deviation for each of the traits.

Preliminary analyses to determine the fixed effects included in the model were carried out using SAS (SAS, 2001). All two-way interactions were non-significant and therefore were not included in the models. Phenotypic and genetic correlations were estimated using ASREML (Gilmour *et al*., 1999). Two models were fitted, one without and one with adjustment of CFW and FD for ewe lambing status. Both were bivariate animal models. For Model 1, the fixed effects included were : year of birth, stud, age of dam and type of birth and rearing. For NLW sire of the lamb born from the ewe was also fitted as a fixed effect. Model 2 was as Model 1, but with NLW fitted as a fixed effect for CFW and FD, thus adjusting these traits for 'lambing status' of the ewe. Day of birth of the ewe was fitted as a linear covariate in both models. Model 2 was not fitted to CFW and FD of rams and of ewes at 16 months of age, as they were non-reproducing animals and were therefore not influenced by lambing status.

Table 1. Number of records available, simple means, standard deviations (s.d.) and range for each trait

Trait		Months of age	n	Mean	s.d.	Range
NLW		28	2113	0.58	0.54	0 – 2
		40	2113	0.83	0.64	0 – 2
		52	2113	0.93	0.71	0 – 3
		64	2113	0.92	0.74	0 – 3
CFW	Ram	10	2203	2.27	0.55	0.6 – 4.7
		16	2183	2.93	0.60	0.9 – 4.9
	Ewe	16	2108	4.37	0.74	1.4 – 7.3
		28	2015	4.85	0.83	2.3 – 9.1
		40	1942	5.07	0.87	1.9 – 8.6
		52	1849	5.02	0.86	2.4 – 8.1
		64	1176	5.03	0.86	2.5 – 8.6
FD	Ram	10	2205	21.3	1.83	15.3 – 28.5
		16	2182	22.6	2.21	16.8 – 30.5
	Ewe	16	2108	22.2	1.93	16.4 – 29.0
		28	2022	24.0	2.03	18.0 – 31.1
		40	1943	24.8	2.13	18.5 – 32.6
		52	1851	25.1	2.16	17.5 – 33.1
		64	1176	25.5	2.39	19.0 – 33.9

RESULTS AND DISCUSSION

The phenotypic correlations presented in table 2 were generally low with many close to zero. Phenotypic correlations between NLW and CFW at 16 months of age were all close to zero. All estimates between NLW and CFW changed sign when model 2 was fitted. Phenotypic correlations between NLW and CFW using model 1 at ages greater than 16 months became more strongly negative with age. However when model 2 was fitted the magnitude of the estimates was reduced and did not change greatly with age. Phenotypic correlations between NLW and FD were generally low and close to zero. Estimates changed from low and negative with Model 1 to low and positive with Model 2, the greatest change occurring at 64 months of age.

The genetic correlations (table 3) between NLW and CFW were generally low and negative. From Model 1, genetic correlations between NLW and ewe CFW at ages greater than 16 months were generally higher than correlations between NLW and ram CFW. This was similar for Model 2, but estimates between NLW and ewe CFW were generally lower. For both Models 1 and 2 the genetic correlation between CFW and NLW was greatest at 40 months, decreasing with age. Genetic correlations between NLW and FD were generally low and positive for both models, except at 64 months, when it was low and negative for both models. Using Model 2 did not have a large affect, except at 40 months of age, in which case the genetic correlation increased substantially.

Table 2. Phenotypic correlations between number of lambs weaned, clean fleece weight and fibre diameter

	Ewe age	Model used	NLW 28	NLW 40	NLW 52	NLW 64
CFW	16	1	0.01 (0.024)	0.04 (0.023)	0.03 (0.023)	0.05 (0.023)
	28	1	-0.15 (0.24)			
		2	**0.11 (0.031)**			
	40	1		-0.16 (0.023)		
		2		**0.02 (0.032)**		
	52	1			-0.17 (0.023)	
		2			**0.08 (0.032)**	
	64	1				-0.26 (0.026)
		2				**0.10 (0.039)**
FD	16	1	0.10 (0.023)	0.03 (0.023)	0.02 (0.023)	0.03 (0.023)
	28	1	-0.02 (0.024)			
		2	**0.04 (0.031)**			
	40	1		0.01 (0.024)		
		2		**0.02 (0.031)**		
	52	1			-0.11 (0.024)	
		2			**0.04 (0.032)**	
	64	1				-0.16 (0.028)
		2				**0.08 (0.039)**

There is variation in published parameters and their accuracy. Fogarty (1995) reported genetic correlations of –1.13 (0.79) and –0.03 (0.21) between NLW and CFW and 0.41 (0.24) between NLW and FD for Merinos. Merino Genetic Services (Pers. Comm. D Brown, 2002) assumes a genetic correlation of both CFW and FD with NLW of 0.0 at all ages, whereas Rampower (Pers. Comm. K. Atkins, 2002), another major Australian Merino genetic evaluation service, assumes a value of 0.1.

CONCLUSION

Although there was some inconsistency (e.g. for NLW at 64 months), our findings suggest that selection focussing on increasing CFW could result in decreased NLW. The genetic correlation between NLW and FD was generally weaker than for CFW, but was also in the wrong direction, suggesting that genetic reduction of FD could also result in decreased NLW. When compared with the estimates assumed in the major Merino genetic evaluation services in Australia, the agreement was good for FD, but not for CFW. The issue is worthy of further consideration.

Table 3. Genetic correlations between number of lambs weaned, clean fleece weight and fibre diameter

		Age	Model used	NLW 28	NLW 40	NLW 52	NLW 64
CFW	Ram	10	1	-0.33 (0.178)	-0.15 (0.587)	-0.13 (0.287)	0.19 (0.211)
		16	1	0.07 (0.170)	0.25 (0.587)	-0.04 (0.279)	0.36 (0.220)
	Ewe	16	1	-0.32 (0.178)	-0.37 (0.863)	-0.55 (0.331)	0.43 (0.214)
	Ewe	28	1	-0.35 (0.168)			
			2	**-0.19 (0.180)**			
		40	1		-0.40 (0.616)		
			2		**-0.41 (1.047)**		
		52	1			-0.18 (0.277)	
			2			**-0.13 (0.299)**	
		64	1				-0.20 (0.246)
			2				**-0.08 (0.254)**
FD	Ram	10	1	0.19 (0.178)	0.22 (0.586)	0.11 (0.287)	0.09 (0.222)
		16	1	0.22 (0.166)	0.29 (0.658)	0.09 (0.270)	0.07 (0.209)
	Ewe	16	1	0.18 (0.162)	0.34 (0.625)	0.19 (0.274)	0.26 (0.210)
	Ewe	28	1	0.05 (0.161)			
			2	**0.09 (0.159)**			
		40	1		0.11 (0.512)		
			2		**0.36 (0.582)**		
		52	1			0.08 (0.273)	
			2			**0.10 (0.268)**	
		64	1				-0.13 (0.247)
			2				**-0.07 (0.247)**

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