THE UTILITY OF VISUAL ASSESSMENT IN PREDICTING BREEDING OBJECTIVES FOR MERINO SHEEP

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INTRODUCTION

Visual classing of Merinos has always been a part of the selection process. In recent times, there has been a trend towards selection on a combination of visual classing and objective measurement. Lewer and MacLeod (1990) showed that formally combining the two sources of data could be more efficient than using either separately in a single stage selection index. This paper examines the value of visually classed selection criteria with and without objectively measured variates.

MATERIALS AND METHODS

Genetic and phenotypic parameter estimates were derived by paternal half-sib procedures from two data sets. The first was from the Base Flocks at the Great Southern Agricultural Research Institute at Katanning, Western Australia (Lewer et al, 1990). These data varied in number according to variate, but ranged between about 1500 records in 180 sire groups and 2200 records in 285 sire groups. The second source of data was the South African Grootfontein Agricultural College stud flock (Lewer, 1991), and comprised about 4000 records and 240 sire groups.

Two different breeding objectives were derived as detailed in Table 1.

Table 1. Breeding objectives derived for the study of the value of visually classed selection criteria. BO1 and BO2 are alternative breeding objectives.

Traits in breeding objective	Relative economic values		Equivalent market price	
	BO1	BO2	BO1	BO2
Clean fleece weight	49.67	18.51	$8/kg	$3.50/kg
Average fibre diameter	-9.12	-22.97	-40c/u	-$1/u
Hogget liveweight	0.72	0.72	50c/kg	50c/kg

As parameter estimates were not available between reproductive characteristics and the visually classed traits these traits were omitted. The first breeding objective (BO1) assumes the WOOLPLAN default relative economic values at the date of writing. In the second breeding objective, the market price changes per micron fibre diameter and per kg clean fleece weight were replaced with $1 and $3.50 respectively. Two dissimilar breeding objectives were studied to investigate the sensitivity of the visual variates as predictors.

The value of each selection criterion was defined as the percentage decrease in genetic gain resulting from its ommision from the selection index (Cunningham ,1969). A "valuable" selection criterion was arbitrarily defined as one percent for this study. The correlation between each index and the breeding objective was calculated to provide a measure of comparison. The standard deviation of the index estimates the overall economic response for a selection intensity of one. Responses were estimated for each trait in a similar manner. Five selection indices were constructed to predict each of the breeding objectives with each set of parameter estimates as follows:

- I1 The variates in the selection index were the same as the traits in the breeding objective.
- I2 All of the objectively measured and subjectively graded variates included.
- I3 Only the subjectively graded selection criteria used.
- I4 Objectively measured criteria with the valuable visually graded variates from I2.
- I5 Only the subjectively graded variates shown to be valuable in I3.

The variates measured or visually assessed in the two flocks appear in Table 2.

RESULTS AND DISCUSSION

Table 3 summarises the results where the Katanning flock estimates and selection criteria were used. I1 demonstrates the rate of gain which was achieved where only the traits in the breeding objective were used as selection criteria. A comparison between I1 and I2 shows that for either breeding objective, adding the subjective criteria to the objectively assessed variates increases overall response by 12-13%. Where only the subjective grades were used as selection criteria (I3), there was a decrease in overall response of 39 and 48 in BO1 and BO2 respectively, compared with the I2 indices. Where a higher relative economic value was used for FD (BO2), responses in that trait increased compared with BO1,but there was a loss in CFW, albeit small, in all indices except I3.

Different visual variates became valuable as the breeding objective was changed. More subjectively assessed criteria exceeded 1% value when the objectively measured criteria were omitted as the correlation between the index and the breeding objective was greater for I1 than I3. FCS was the only variate which contributed consistently regardless of the breeding objective due to favorable correlations with all of the traits in the objective. CHR and UL were also valuable selection criteria in BO1 and HND and WNK in BO2.
Omitting selection criteria which had low value reduced overall economic gain by 1.4 to 4.3% for the different indices but only slightly changed the pattern of trait responses.

Table 4 contains a summary of results for the Grootfontein estimates and variates. The South African Fleece Testing Service routinely provides measurement of CRF and STL but both contributed less than 1% to genetic improvement.

Both HCK and WRI were consistently valuable across breeding objectives. In BO1, FC had a value greater than 1% value in I3, but it's value fell to 0.20% in I5. Up to 0.16 kg of
With BO1, most indices led to an increase in FD. The responses in CFW were invariably .pa

Table 2: Variates recorded in each flock, abbreviation used and description of each.

Variate	Abbrev.	Flock[+] K	Flock[+] G	Description
Clean fleece weight	CFW	*	*	Weight of clean scored wool.
Average fibre diameter	FD	*	*	Average fibre diameter of mid-side sample.
Hogget bodyweight	HBW	*	*	Live weight at 12-15 months of age.
Greasy fleece weight	GFW	*		Weight of wool and impurities.
Crimp frequency	CRF		*	Measured crimps per 25mm.
Staple length	STL		*	Average length of five staples of wool.
	All of the above were objectively measured.			
Underline	UNL	*	*	Quantity and quality of wool under the sheep.
Hocks	HCK	*	*	Straightness of the rear legs.
Handle	HND	*		Softness of the wool.
Character	CHR	*		Staple structure and crimp definition.
Visual fineness	FIN	*		Visual fineness based on crimps/cm.
Condition	CND	*		Wax content of the wool.
Face cover score	FCS	*		Amount of wool on the face.
Neck wrinkle	WNK	*		Skin folds around the neck.
Breech wrinkle	WBR	*		Skin folds around the hind quarters.
Side wrinkle	WSD	*		Skin folds alond the side of the sheep.
Overall score	OAS	*		General impression.
Staple tip	STP		*	Shape of the tip of the staple.
Wrinkle score	WRI		*	Amount of skin folds over the whole sheep.
Fleece variation	FLV		*	Variation in visual fineness over the fleece.
Yolk	YLK		*	Amount and colour of wool grease.
Wool quality	QUL		*	Character and lock.
Head	HD		*	Size and shape of the head.
Face cover	FC		*	Harshness of the face cover.
Front	FR		*	Soundness of front legs and shoulders.
Pasterns	PST		*	Uprightness of front and rear pasterns.
Conformation	CON		*	General shape of the sheep.

[+] K = Base Flocks, Katanning; G = Grootfontien Stud.

Table 3: Value of variates, correlations between each index and the breeding objective (r_{IH}), standard deviation of each index (s_I) and genetic gains (dG) in each trait in the breeding objective for a selection intensity of one on the index using the parameter estimates from the Katanning Merino flock. Variates not reaching 1% value were omitted.

	Breeding objective 1					Breeding objective 2				
	I1	I2	I3	I4	I5	I1	I2	I3	I4	I5
CFW	44.71	16.07		18.96		0.95	0.02		0.14	
FD	22.70	14.68		17.02		93.53	46.62		50.15	
HBW	0.14	0.38		0.50		0.46	0.01		0.26	
GFW		2.30		3.46			0.01		0.02	
UNL		1.21	8.20	1.74	11.09		0.12	0.00		
HCK		0.16	0.82				0.83	1.95		2.01
HND		0.50	5.26		4.99		1.11	17.34	2.02	24.45
CHR		3.10	16.94	4.21	17.70		0.24	0.79		
FIN		0.74	4.67		4.25		1.05	0.11	0.99	
CND		0.08	0.19				0.38	2.62		2.46
FCS		1.69	8.25	1.47	9.28		2.17	16.22	1.93	17.33
WNK		0.18	0.08				1.62	6.44	2.91	6.23
WBR		0.17	0.40				0.40	1.85		1.37
OAS		1.12	0.06	1.05			0.57	1.07		1.39
r_{IH}	0.63	0.71	0.44	0.70	0.42	0.70	0.79	0.41	0.75	0.40
s_I	10.88	12.31	7.51	12.10	7.32	19.30	21.65	11.24	20.71	11.08
dG -CFW	0.14	0.22	0.10	0.17	0.10	-0.01	-0.03	0.01	-0.02	-0.01
- FD	-0.39	-0.42	-0.24	-0.38	-0.21	-0.87	-0.96	-0.46	-0.91	-0.47
-HBW	0.29	0.46	0.53	0.39	0.47	0.03	0.13	0.57	0.19	0.56

Table 4: Value of variates, correlations between each index and the breeding objective (r_{IH}), standard deviation of each index (s_I) and genetic gains (dG) in each trait in the breeding objective a selection intensity of one on the index using the parameter estimates from the Grootfontein stud flock. Variates not reaching 1% value were omitted.

	-------Breeding objective 1-------					-------Breeding objective 2-------				
	I1	I2	I3	I4	I5	I1	I2	I3	I4	I5
CFW	35.30	0.38		1.32		1.85	0.10		0.10	
FD	8.21	7.99		7.99		96.24	18.11		20.09	
HBW	1.42	11.08		11.55		1.99	0.95		1.80	
UNL		11.98	26.19	12.79	29.70		0.03	0.45		
HCK		2.25	4.36	1.88	7.56		5.81	15.79	5.04	16.41
STP		0.53	0.06				1.26	14.09	2.03	16.91
WRI		2.78	10.08	2.79	11.40		4.33	13.23	5.50	13.63
FLV		0.53	1.41		2.11		0.09	0.18		
YLK		0.33	0.26				2.26	6.37	2.46	6.85
HD		0.39	2.54		3.27		1.05	2.40	1.42	2.62
FC		1.54	1.90	1.64	0.20		0.19	2.90		2.97
CON		1.83	0.68	2.92			0.91	1.20		1.05
r_{IH}	0.48	0.64	0.42	0.62	0.40	0.68	0.82	0.64	0.81	0.63
s_I	12.09	16.06	10.52	15.86	10.29	17.44	21.15	16.53	20.84	16.31
dG -CFW	0.21	0.32	0.26	0.31	0.26	-0.04	-0.10	-0.16	-0.09	-0.13
- FD	-0.12	0.05	0.22	0.01	0.26	-0.79	-1.02	-0.87	-0.99	-0.84
-HBW	1.08	0.72	-0.49	0.67	-0.39	0.02	-0.43	-0.65	-0.41	-0.67

higher than those recorded for equivalent indices in Table 3. Indices which did not include the objectively measured selection criteria were unsuccessful in increasing HBW.
All BO2 indices which included visual variates were associated with negative response in HBW. CFW was sacrificed for greater improvement in FD in BO2 indices compared with BO1.

Overall responses were higher for the I1 indices using this set of parameter estimates than for the Katanning set. Again, the pattern was similar, with changing emphasis on different selection criteria in different sets of variates, and in different breeding objectives. More of the visually assessed traits were valuable when the ratio of FD/CFW absolute economic values was higher due to the correlation structure of the data.Of the 22 subjective selection criteria studied at the two sites, 17 exceeded 1% value at least once. Given these parameter estimates, many visual traits can contribute to increases in the efficiency of selection.

Traditional breeders may be concerned that many visual selection criteria have been omitted from the breeding objective as they would claim that they require independent improvement in these characteristics. As long as there are no defined economic values, these characteristics cannot be included in the breeding objective. Change in selection criteria, and also in those variates omitted from the selection indices, will still occur,
but only change as a correlated response to change in the traits in the objective. Hence omitting criteria which lack value will not change their response to selection.

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