BREEDING OBJECTIVES IN SHEEP: DETERMINING RELATIVE ECONOMIC VALUES FOR PRODUCTION TRAITS IN FLOCKS OF DIFFERING COMPOSITION

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SUMMARY

A computer simulation of two commercial Merino flocks was used to calculate relative economic values for clean fleece weight, fibre diameter, liveweight and reproductive rate under various combinations of low, medium and high commodity prices for livestock and wool. Numbers in each flock were adjusted to achieve a constant feed consumption despite changes to liveweight and reproductive rate. Flock composition had little effect on the relative economic values except under extreme price conditions. Increases in liveweight reduced profitability except in flocks where fleece values were low, livestock prices were high and wether offspring were sold at an early age. Increases in reproductive rate generally resulted in small positive or small negative changes in profitability.

INTRODUCTION

Both the selection of traits and the relative emphasis applied to changing them determine the direction of breeding programs. Where that emphasis is based on the expected economic outcome of genetic change in their clients' flocks, stud sheep breeders need to consider the variation in flock composition between those flocks. For example, in some commercial flocks, no wethers are retained beyond lamb age while, in others, wethers are retained to 5 years of age or more. The purpose of this paper is to examine the effect of both flock composition and varying price regimes for the major components of income on the relative economic values of 4 major genetic traits.

METHOD

A computer program was developed to model a commercial sheep farm. The model was effectively an economic one but with the added biological constraint that flocks with different composition, different reproductive rates or with sheep of different liveweight were adjusted in size to a constant level of feed input. Adjustments were derived from the computer program *GrazFeed* (CSIRO 1990).

The adjustments were made in recognition of the need to evaluate genetic change under conditions which assume optimal management decisions (James 1982; Smith et al. 1986; McArthur 1987; Ponzoni 1988a), thereby removing any confounding of genetic improvement and management improvement. It was considered that the best approach to handling the extra costs associated with running larger sheep or more fecund sheep was to adjust the size of the flock. This now seems a general conclusion amongst geneticists (Jones 1982; Atkins 1987; Ponzoni 1988a) and one most like the decision that commercial wool producers would take (James 1986).

The effects of genetic change in each of 4 traits were evaluated by summing the changes in gross margin which would follow the introduction of genetically superior seedstock for 1 mating only. Future changes in gross margin were discounted by 5% per annum to produce a Net Present Value (NPV) for each trait. The horizon for evaluating genetic change was set at 20 years. The amount of genetic change introduced was a 1% increase in the mean adult expression of clean fleece weight (CFW), fibre diameter (FD), liveweight (LW) or reproductive rate (RR). The mean adult trait values were 3.6 kg, 22 micron, 45 kg and 85% lambs weaned per ewe joined for CFW, FD, LW and RR respectively, reflecting values typical of commercial, medium wool Merino flocks (Abbott unpublished, Atkins 1987).

The structures of the two flocks differ significantly. Flock 1 has 2731 breeding ewes and sells 1131 woolly wether lambs annually. Flock 2 has 1533 breeding ewes, breeds 658 wether lambs and retains most of these for 6 shearings. It is estimated that both of these flocks would consume the same amount of feed annually for the same level of individual productivity. Gross margins were calculated for a range of commodity prices, characterised as low, medium and high. For fibre diameter, the descriptions refer to the price differential between wools differing by 1 micron in mean fibre diameter. The prices used are shown in table 1. The fibre diameter premium was 10% for all cases.

Table 1. Commodity prices used to calculate the gross margins of sheep production. For comparison, the values used by WOOLPLAN (Ponzoni 1988b, 1991) are also included.

	Commodity price conditions			Woolplan options		
	Low	Medium	High	1	3	4
CFW (cents/kg)	300	600	1800	800	800	800
FD (cents/mic/kg)	-30	-60	-180	-40	-80	-160
LW (cents/kg)	30	60	120	72	72	72

RESULTS

The Net Present Values of a 1% increase in each of the four traits were calculated. For each flock and each set of price conditions, the NPV of each trait was divided by the NPV of the trait CFW and this is reported as the relative economic value (REV) of each trait. The REVs of these traits for 3 different price scenarios are shown in table 2.

DISCUSSION

Units of 1% of each trait's mean value were preferred to standard units (1 kg, 1 micron, 1 lamb per ewe) because percentage increases better present the relativity between traits to producers and advisers. For these four traits, the potential rates of genetic improvement are similar when considered in percentage terms (Land et al. 1983; Bradford 1985; Atkins 1987). Standard unit increases, on the other hand, refer to changes of 28%, 4%, 2% and 118% for CFW, FD, LW and RR respectively compared to the mean values expected in commercial Merino flocks. The purpose of this paper is to examine the sensitivity of REVs to flock structure and price. Evaluation of standard unit increases clouds the intuitive interpretation of the results. The value of a 1% change in the mean adult expression of each trait can be converted to the value of a one unit change by dividing the relevant REV by 0.036 (kg of CFW), 0.22 (microns of FD), 0.45 (kg of LW) and 0.0085 (number of lambs weaned per ewe).

Table 2. The relative economic values of 4 traits in wool producing flocks of two different structures for 3 combinations of commodity prices

	Relative economic values ($) of a 1% increase in each trait					
Livestock prices : Wool & FD prices :	High Low		Medium Medium		Low High	
	Flock 1	Flock 2	Flock 1	Flock 2	Flock 1	Flock 2
Clean fleece weight	1.00	1.00	1.00	1.00	1.00	1.00
Fibre diameter	-2.02	-2.01	-2.02	-2.01	-2.02	-2.01
Liveweight	0.32	-0.45	-0.33	-0.58	-0.51	-0.62
Reproductive rate	0.87	0.28	0.05	0.04	-0.17	-0.02

Table 3. The relative economic values from WOOLPLAN, presented in units of 1% of mean trait value

	Relative economic values ($) of a 1% increase in each trait		
WOOLPLAN option :	1	3	4
Clean fleece weight	1.00	1.00	1.00
Fibre diameter	-1.12	-2.24	-4.48
Liveweight	0.18	0.18	0.18
Reproductive rate	0.40	0.40	0.40

When commodity prices for meat, livestock, wool and fibre fineness all move together, the relative economic values of the 4 traits vary little between the two flock structures. This relationship is illustrated in the centre columns of table 2 where all prices are medium. Selection for increased liveweight reduces profitability, chiefly because the reduction in numbers which is a consequence of the increased feed intake per sheep reduces the number of animals available for sale and present for shearing. Their increased sale value per head does not compensate completely for the decrease in numbers. Selection for increased RR has a relatively low economic value compared to the wool traits CFW and FD and, interestingly, this varies little whether the flock sells all wether lambs or none.

When prices for meat and livestock are opposed to those for wool traits, there is a significant interaction between flock structure and price conditions (table 2). When livestock prices are high and wool prices are low, selection for increased LW is profitable in flock 1 but not in flock 2. Increasing RR is nearly as profitable as increasing CFW in flock 1. The opposition of wool and meat price movements has occurred in the Australian sheep industry several times in the last 15 years. Most notably in the mid to late 80s, commercial strong wool flocks were receiving relatively low prices for wool but high prices for wethers eligible for export as live sheep. Deliberate attempts to breed for such a market appears to require a distinctly different set of REVs from those required for other sheep production systems.

The effects of lower or higher fibre diameter premiums on the REVs are not shown here but were investigated. The effect was principally confined to the REV for FD and had little effect on the relativity between economic values for CFW, LW and RR.

The results also suggest that selection against LW is appropriate under most conditions, as was also reported by Atkins (1987). Selection against liveweight is unlikely to be acceptable to most breeders who consider smaller sheep to be less robust and more difficult to rear. These results suggest that, at the least, some selection should be practised to prevent increases in liveweight in most circumstances.

WOOLPLAN, the Australian national sheep performance recording scheme (Ponzoni 1991), now offers four sets of REVs to sheep breeders and these are presented in table 3 with units changed to those used in this paper. Although the product prices are comparable to the 'medium' set (table 1) the REVs of LW and RR under WOOLPLAN are higher than those in table 2 except for flock 1 with high livestock prices and low wool prices. This anomaly appears to be the result of the method of evaluating the economic impact of larger or more fecund sheep used by Ponzoni (1988b). The assumption that fixed resources are under-utilized and that feed costs are the only expense likely to rise when sheep are larger or more prolific will always lead to an overestimate of the value of such genetic change.

CONCLUSIONS

Stud breeders producing rams and semen with a view to improving the profitability of commercial wool production should aim to put strong emphasis on clean fleece weight improvement and fibre diameter reduction virtually regardless of the flock composition or selling policies of their clientele. Reproductive rate apparently deserves little emphasis and increases in liveweight are contra-indicated. The only exception appears to be for stud breeders of low fleece value sheep who expect their clients to sell wethers at a young age and for high prices. These breeders could rationally put more emphasis on improvements in reproductive rate and some emphasis on increasing liveweight.

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