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# STUDIES OF INDICES USED BY THE AUSTRALIAN MERINO SOCIETY IN RAM SELECTION:

## II. GENETIC AND ECONOMIC CONSEQUENCES

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### INTRODUCTION

The purpose of this paper is to assess the genetic and economic consequences of using the Australian Merino Society (AMS) indices ($I_1$ and $I_2$) described by Ponzoni (1985a), and to compare them with an index derived formally ($I_D$) described in the guidelines for National Sheep Performance and Recording Services for Merino sheep (Lewer, Morgan, Ponzoni, and Vanrenen 1984). $I_D$ is a linear index ($b_1$ (clean fleece weight) + $b_2$ (fibre diameter) + $b_3$ (hoggett live weight)) and it was derived assuming the traits in the breeding objective were clean fleece weight, fibre diameter, reproductive rate (number of lambs weaned or number of hoggets present at 1½ years of age), hogget live weight and mature ewe live weight, with no restrictions imposed on any traits.

### MATERIALS AND METHODS

The theoretical correlations (James 1982) among $I_{L1}$, $I_{L2}$ and $I_D$ were calculated. $I_{L1}$ and $I_{L2}$ are the linear approximations of $I_1$ and $I_2$ (Ponzoni 1985a). The predicted genetic gains in clean fleece weight (CFW), fibre diameter (FD), reproductive rate (RR), hogget live weight (HW) and mature live weight (MW) resulting from a selection intensity of one standard deviation on the index were calculated as:

$$g = (b' G)\sigma_I^{-1}$$

where g is the vector of genetic gain in each trait, b is the vector of index coefficients, G is a 3 x 5 genetic variance - covariance matrix between characters in the index and traits in the objective, and $\sigma_I$ is the standard deviation of the index. The phenotypic and genetic parameter values assumed were the same as those in Lewer *et al.* (1984).

The genetic gain in economic units (EG) achieved by each index was calculated as:

$$EG = \sum_{i=1}^{5} v_i \; g_i$$

where v and g represent the economic value and the genetic gain, respectively, for each trait. Three price relationships between clean wool weight and fibre diameter were investigated (25.0, 16.7 and 12.5) (*e.g.*, the value of one kg of clean wool is 25 times greater than the change in price of one kg of clean wool caused by a change of one micron in fibre diameter). Within each price relationship EG was expressed as a percentage of the value of the index giving the greatest EG.

## RESULTS AND DISCUSSION

The theoretical correlations among the indices were:

$$I_{L1} - I_{L2} = 0.95$$

$$I_{L1} - I_{D} = 0.94$$

$$I_{L2} - I_{D} = 0.79$$

The correlations between two indices indicates the relative efficiency of the index when the other is the "correct" one. For example, if $I_{L1}$ were the "correct" index, ise of $I_{L2}$ would achieve 95 per cent of the gain that could be achieved by $I_{L1}$. The correction values show that the most serious losses of efficiency would occur if $I_{L2}$ were used but $I_{D}$ were the correct index, or *vice versa*. $I_{L1}$ and $I_{D}$ were highly correlated, these results being consistent with those of Ponzoni (1985b).

TABLE 1: PREDICTED GENETIC GAIN IN CLEAN FLEECE WEIGHT (CFW), FIBRE DIAMETER (FD), REPRODUCTIVE RATE (RR), HOGGET LIVE WEIGHT (HW), AND MATURE LIVE WEIGHT (MW) RESULTING FROM A SELECTION INTENSITY OF ONE STANDARD DEVIATION ON EACH INDEX

| Index † | Trait | | | | |
|---|---|---|---|---|---|
| | CFW (kg) | FD (microns) | RR | HW (kg) | MW (kg) |
| $I_{L1}$ | 0.109 | - 0.60 | 0.010 | 0.7 | 0.6 |
| $I_{L2}$ | 0.069 | - 0.83 | 0.009 | 0.4 | 0.3 |
| $I_{D}$ | 0.110 | - 0.49 | 0.012 | 1.0 | 0.8 |

† $I_{L1}$ and $I_{L2}$ are linear approximations of AMS indices. $I_{D}$ is an index derived using selection index theory.

Table 1 shows the predicted genetic gain in CFW, FD, RR, HW and MW resulting from a selection intensity of one standard deviation on $I_{L1}$, $I_{L2}$ and $I_{D}$. $I_{L1}$ placed more emphasis than $I_{L2}$ on all traits except FD. Similarly, $I_{D}$ placed more emphasis than $I_{L1}$ and $I_{L2}$ on all traits except FD.

Table 2 shows the total genetic gain in economic units achieved by each index, assuming different price relationships between wool weight and fibre diameter. The economic values of CFW and FD in $I_{D}$ were calculated assuming that the value of one kg of clean wool was 25 times greater than the change in price of one kg of clean wool caused by a change of one micron in fibre diameter. When this price relationship was used $I_{D}$ gave the greatest gain and $I_{L2}$ the smallest. Two other price relationships were examined (16.7 and 12.5, achieved by multiplying the value assumed in $I_{D}$ of one micron change in fibre diameter by 1.5 and 2.0, respectively). $I_{L1}$ resulted in the greatest gains when the price relationship was 16.7, whereas $I_{L2}$ was superior to the other indices when the relationship was 12.5. Note, however, that if either 16.7 or 12.5 were identified as "true" price relationships between wool weight and fibre diameter a formal index could be derived which would be at least as efficient as $I_{L1}$ of $I_{L2}$.

It is concluded that, in agreement with the findings of Ponzoni (1985b), the AMS index $I_1$ gives results that are very similar to those obtained with formally derived indices that include the same characters (*i.e.* CFW, FD, HW). The new AMS index ($I_2$) places greater emphasis on fibre dia-

meter than $I_{L1}$, this being achieved at the expense of reduced emphasis on other economically important traits. The economic consequences of changing from $I_{L1}$ to $I_{L2}$ will vary depending on the relationship between the price of one kg of clean wool and the change in value per unit change in fibre diameter.

TABLE 2: TOTAL GENETIC GAIN IN ECONOMIC UNITS (EXPRESSED AS A PERCENTAGE OF THE INDEX GIVING THE GREATEST GAIN) ASSUMING DIFFERENT PRICE RELATIONSHIPS BETWEEN CLEAN WOOL WEIGHT AND FIBRE DIAMETER

| Index † | Clean wool weight: fibre diameter price relationship | | |
|---|---|---|---|
| | 25.0 | 16.7 | 12.5 |
| $I_{L1}$ | 99 | 100 | 97 |
| $I_{L2}$ | 89 | 98 | 100 |
| $I_D$ | 100 | 99 | 94 |

† $I_{LI}$ and $I_{L2}$ are linear approximations of AM indices.
$I_D$ is an index derived using selection index theory.

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