SUMMARY

The Dohne Merino is a South African bred mutton-woolled sheep specifically bred for the sour-grassveld areas. Although phenotypically well documented, little was known about its genetic development in economically important traits until the advent of BLUP-methodology. This paper describes genetic trends in greasy fleece mass and body mass traits over the whole development period and three distinct phases of development. Genetic progress was slow but obvious differences in the response gradients occurred in the three developmental phases. Within phases the different traits measured reacted similarly.

INTRODUCTION

The Dohne Merino is one of several South African sheep breeds (also the Afrino, Dormer, Dorper, Vandor and Van Rooy) which were specially developed for certain harsh agricultural environments, while at the same time satisfying specific market requirements. The aim in developing the Dohne Merino was to evolve a mutton-woolled sheep that was adapted to the climatic and veld conditions in the sour-grassveld areas in the Eastern parts of South Africa (Kotze, 1951). Further requirements were a high fertility, a high lamb growth rate, good quality wool without hair, coloured fibres or kemp, and the ability to lamb in autumn as well as in spring.

Commencing in 1939 at the Dohne Research Station, German Merino (presently South African Mutton Merino) rams were mated to Merino ewes to produce half-bred lambs from which the Dohne Merino was developed.

Although based on objective measurements and scientific methods, the development of the Dohne Merino was not executed as a selection experiment with a genetic control, but as a comprehensive breeding and selection process, while also considering the future acceptability of the breed to the farming industry. Therefore there was no scientific procedure available to measure genetic progress in the economic traits of the breed until BLUP-methodology became accessible for general use.

The purpose of this paper is to discuss some genetic trends in the Dohne Merino as a typical example of the application of BLUP-methodology to study the genetic history of a new farm animal breed during its initial stages of development.
MATERIAL AND METHODS

All Dohne Merino sheep born during the development period 1948 to 1985 (approximately 10,000 individuals) were included in this study. Data included observations on body mass at birth, and at 100 days, 180 days and 18 months of age, as well as greasy fleece mass at the latter age.

The BLUP Animal Model Program of the South African Department of Agriculture and Water Supply, as adapted and further developed by Delport (1989) was used to analyse the data.

A mixed model was used to describe the observations. Following Blair (1981) who worked with similar sheep data, all first order interactions were excluded from the model which is given in the following equation.

\[ Y_{ijklm} = \mu + a_i + b_j + c_k + d_l + f_m + e_{ijklm} \]

where \( Y_{ijklm} \) is an individual phenotypic observation,
\( \mu \) is the population mean,
\( a_i \) is the sex effect (male or female),
\( b_j \) is the fixed age of dam effect (mature or immature),
\( c_k \) is the fixed birthstate effect (single or multiple),
\( d_l \) is the fixed average birth year effect, free from genetic trend,
\( f_m \) is the random effect of the \( m^{th} \) animal in the \( i^{th} \) year (predicted breeding value), and
\( e_{ijklm} \) the random residual effect for each observation.

As such, the model represents a single trait animal model in which breeding values are predicted for all animals.

Due to the large number of equations involved, iterative procedures were employed. Blair and Pollak (1984) considered solutions converged when the convergence criterion was less than 0.0001 kg (sheep data) for both fixed and random effects. In this study iterations were limited to 300 rounds and then considered as converged.

Genetic trends were obtained by averaging the breeding values of animals born within specific years (excluding base population animals). Regressions were employed to determine the genetic trend over the entire period as well as for three distinct phases. These were the initial phase (1948 - 1955) when small numbers of crossbred animals were available, the expansion phase (1956 - 1975), and the performance testing phase (1976 - 1985) during which selection was primarily based on performance indices.
RESULTS

The initial means and genetic trend gradients of five production traits for the total period of study (1948 to 1985) and four traits for the three developmental phases are shown in Table 1.

Table 1  Mean initial mass and genetic trend gradients (kg)

<table>
<thead>
<tr>
<th>Trait</th>
<th>Initial mass</th>
<th>Total period</th>
<th>1948 - 55</th>
<th>1956 - 75</th>
<th>1976 - 85</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth mass</td>
<td>3.57</td>
<td>0.005</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>100 day mass</td>
<td>22.79</td>
<td>0.045</td>
<td>-0.053</td>
<td>0.068</td>
<td>0.032</td>
</tr>
<tr>
<td>180 day mass</td>
<td>29.23</td>
<td>0.059</td>
<td>-0.052</td>
<td>0.098</td>
<td>0.042</td>
</tr>
<tr>
<td>18 month mass</td>
<td>44.30</td>
<td>0.059</td>
<td>Not measured</td>
<td>0.017</td>
<td>0.129</td>
</tr>
<tr>
<td>Greasy fleece</td>
<td>3.99</td>
<td>0.004</td>
<td>-0.006</td>
<td>0.015</td>
<td>0.001</td>
</tr>
</tbody>
</table>

DISCUSSION

All four traits studied, show slow but positive response trends over the total period of 37 years (about 10 generations). If the initial masses are considered, the value for 18 month mass appears relatively small compared to the regressions for body mass at 100 and 180 days of age. This result is however in agreement with the heritabilities of 0.39 and 0.53 for 100 and 180 day mass, compared to 0.31 for 18 month body mass as found by Fourie (1981) for the same flock. The trend gradients for birth mass and greasy fleece mass are much smaller and of the same order, as are also their initial values.

Genetic improvement took place at rates varying from 0.1% for greasy fleece mass to 0.27% for 18 month body mass which is about one tenth of the rate possible in a well planned single trait selection system.

Such slow progress in individual characteristics is however acceptable in the present situation where the development of a new breed took place and where the total sheep was considered, including many economically important traits as well as breed characteristics to be taken up in the standards of excellence of the new breed.

Comparison of the trends over the three different developmental phases are more interesting. Two body mass traits (100 and 180 day mass) as well as greasy fleece mass showed a negative trend during the initial phase (1948 - 1955) possibly because of small numbers involved and the consequent inbreeding. Body mass at 18 months of age was not measured during this phase.
During the expansion phase (1956 - 1975) selection was primarily subjective, with performance data playing a minor role. However both the 100 day and 180 day mass traits showed a greater response in the second, than in the third (performance testing) phase (1976 - 1985). This result can possibly be ascribed to the fact that although on a subjective basis, these traits were selected for directly during the second phase, while they were selected for indirectly in the third phase when performance data and indices were available for 18 month mass and greasy fleece mass, which then became the directly selected traits.

Body mass at 18 months was the only trait measured, which showed a higher response during the performance testing phase than during the expansion phase. Studied on its own, this result is quite predictable because of the objective, performance based selection in the third phase. On the other hand greasy fleece mass, the other trait subjected to direct objective selection during the third phase, reacted very much like 100 and 180 day body mass in that it showed a much lower response during the third than in the second phase. This was possibly due to the more discriminating selection for wool quality which accompanied selection for greasy fleece mass during the performance testing phase. For instance, much greater emphasis was placed on wool fineness and 23 microns was the maximum cut off limit during this phase.

Another aspect to be considered with regard to the disappointing response during the performance testing phase is that some “unrelated” outside rams from co-operating flocks were used in the stud during 1978, 1980, 1981 and 1982. Graphic representation of the data showed considerably higher variability in breeding values during the third phase, which indicated that while some outside rams were of a higher genetic merit than the homebred rams, others were of a lower standard. All indications are that the breed has not yet reached a genetic plateau and a BLUP-analysis at a later stage might very well indicate a further surge of genetic response. If further new breeds were to be developed at this point in time, one would have been in a much better position to make good use of performance testing and to monitor its development by the use of BLUP-technology.

REFERENCES