IMPROVING REPRODUCTION RATE IN THE SOUTH AFRICAN DOHNE MERINO POPULATION

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SUMMARY

The recent increase in reproduction rate of the South African Dohne Merino stud population was investigated. No significant change in environmental factors could be detected. Initial genetic change in the segment of the population using various management techniques to promote reproduction and lamb survival, was slightly higher than the segment practicing exclusively natural mating. Although further investigation is necessary on account of insufficient data, it can be concluded that no reason exists to suspect that the hardiness and adaptability attributes of the population, as measured by number of lambs weaned, are currently compromised.

INTRODUCTION

Total weight of lamb produced per hectare has the most significant effect on total farm income under South African farming and economic conditions. Measures of net reproduction rate are gene-rally used as a proxy to assess the adaptability of animal populations. The heritability of number of lambs weaned (NLW) is low (Safari et. al. 2007) and a moderate to low genetic response on selection is to be expected. However, NLW is a composite trait depending on the net result of the entire reproduction cycle (Lee *et al*. 2011). The trait is easily constructed from birth and weaning records and does not place an additional burden on breeders. Therefore, NLW was used for the purpose of this investigation.

Recent increases in the frequency of multiple births in the South African Dohne Merino population (Table 1) caused concern that use of techniques to artificially improve reproduction and survival of lambs, might compromise the hardiness and adaptability of the population. The aim of this paper is therefore to investigate the usefulness of NLW to improve reproduction rate.

Table 1 Frequency of single and multiple births in South African Dohne Merinos measured as NLW registered at the breed society

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Singles	4601	5074	6324	10336	11012	11786	13610	14860	14965	11451
Twins	4059	3739	5003	9593	10727	11331	12592	16533	16681	12741
Triplets	213	136	255	684	792	827	1062	1724	1810	1612

MATERIAL AND METHODS

The extent to which South African Dohne Merino breeders make use of drugs to stimulate ovulation rate and of embryo transfer, was established by means of a survey. Fifty percent of breeders use these techniques to varying degrees. This information was used to select data from 27 studs with animals born from at least 2006 in the national Dohne Merino database. The studs were selected on accuracy of data, complete recording, data depth and geographic distribution. Seven of these studs have a history of exclusive natural mating and the rest conduct artificial procedures, on a regular basis. Artificial procedures were defined as the use of synchronization/laparoscopy with pregnant Mare serum PMS linked to the use of lambing pens. The data set comprised of number of ewes that weaned lambs (Table 2) together with complete parentage.

Table 2 Number of ewes with lambing records in 27 selected Dohne Merino studs from at least 2006 to 2015

Lambing opportunity	1st lambing	2nd lambing	3rd lambing	4th lambing
Number observations all data	30556	21508	14274	8167
Natural mating	4436	3165	2193	1332

A fixed effect model (R-lsmeans 2016) was used to identify significant fixed effects for year of measurement, breeder, age at lambing included as a linear regression, lambing season defined as flock year season, contemporary group defined as flock season of the ewe. Thereafter, the data was analysed by a multiple trait mixed model for variance component analysis (AS-Reml 2009). The first 4 lambing opportunities of a ewe were considered as 4 separate traits. The following repeatability model (Figure 1), using the same fixed effects, was fitted as an operational model to make use of all available records:

$$y_{ijklmn} = \mu + a_{i + PEij} + b_j + c_k + d_l + f_m + e_{ijklmn}$$

Where y_{ijklmn} = observation on the ewe weaning a lamb/lambs
μ = mean
a_i = random effect of the ewe
Pe_{il} = permanent environmental (random) effect across lambing seasons
b_j = effect of breeder
c_k = effect of age at lambing included as a linear regression
d_l = effect of lambing season defined as flock year season
f_m = effect of contemporary group defined as flock season, of the ewe
e_{ijklmn} = random error

Figure 1. The model used to estimate the repeatability of number of lambs weaned.

RESULTS

It is accepted that first lambing is a good indication of lifetime reproduction (Lee *et al*. 1996). It can therefore be argued that the use of PMS later in life, will influence the repeatability of lambing performance. Lifetime reproduction of ewes weaning a twin at first lambing (Table 3) outperformed those with lesser performance in both the natural data set and all data. From these results it appears

Table 3 Reproduction rate from 2nd to 4th lambing of ewes weaning 0 to 3 lambs at their first lambing in the natural mating data subset and in all data

1st lambing	2nd lambing natural	All	3rd lambing natural	All	4th lambing Natural	all
0	1.18±0.04	1.23±0.02	1.30±0.06	1.31±0.02	1.32±0.08	1.29±0.03

1	1.20±0.02	1.30±0.01	1.28±0.02	1.35±0.01	1.33±0.03	1.36±0.01
2	1.33±0.03	1.45±0.01	1.45±0.04	1.49±0.01	1.46±0.05	1.47±0.01
3	1.37±0.18	1.55±0.05	1.00±0.25	1.56±0.06	1.08±0.57	1.43±0.08

that the use of drugs has no significant effect on the lifetime reproduction as predicted by 1st lambing. The result is supported by the repeatability of 0.05 for the full data set compared to the 0.06 for the natural sub dataset.

Results for heritability are restricted to the first two lambing opportunities since erosion of data available for third and fourth lambing opportunities resulted in large standard errors. Heritability estimates for all data and for the natural mating data set are presented in Table 4. The genetic correlation between first and second lambing was 0.81±0.22. This estimate did not differ from unity, suggesting that first and second lambing records possibly represented the same trait. In contrast, Bunter and Brown (2013) suggested that reproduction records of ewe lambs were not genetically the same records at 2 and 3 years of age. Heritability at 1st and 2nd lambing for the “natural” group was double that of all the data (Table 4). This result may indicate the loss of some genetic component due to the use of PMS/Laparoscopy during mating.

Table 4 Heritability (h^2) for number of lambs weaned at first and second lambing

	All data	Standard error	Natural mating	Standard errore
h^2 1st lambing	0.02	0.01	0.06	0.02
h^2 2nd lambing	0.02	0.01	0.04	0.03

Heritability estimated from the repeatability model was 0.02±0.01 with a permanent between environmental effect of 0.03±0.00. Therefore, on the basis of genetic co-variance, treatment of the two measurements as one trait may be warranted.

Least square means for the different lambings are presented in Figure 2. The phenotypic trends (Figure 2) indicate negligible positive environmental trends (gradient 0.00 at first lambing) for the total data set and no trend for the natural data set. Slight negative gradients are indicated for all subsequent matings, which are slightly higher for the natural mating sub data set (Figure 2).

Genetic trends (Figure 3) for NLW per lambing (repeatability model) were calculated as a regression on year of birth of the ewe. Gradients of 0.13 for all data compared to 0.03 for the natural mating data set, indicates a faster initial rate of genetic change for all data.

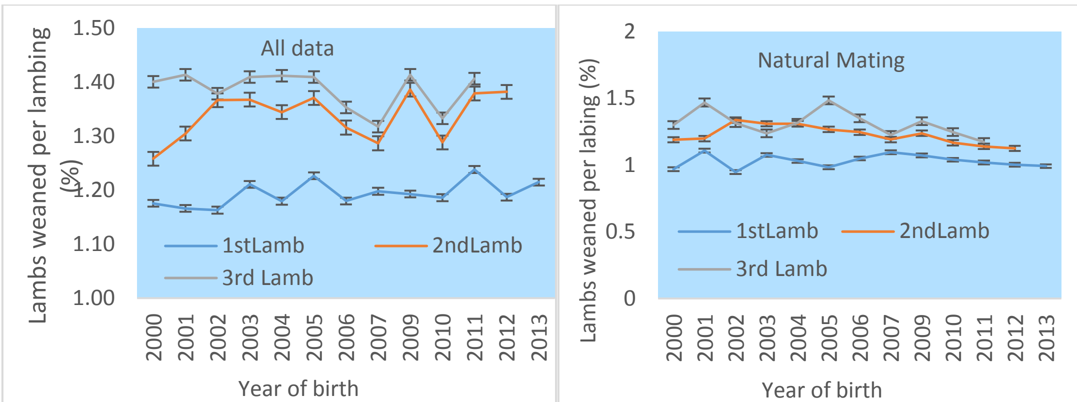

Figure 2 Environmental trend in NLW for all data and the natural mating subset.

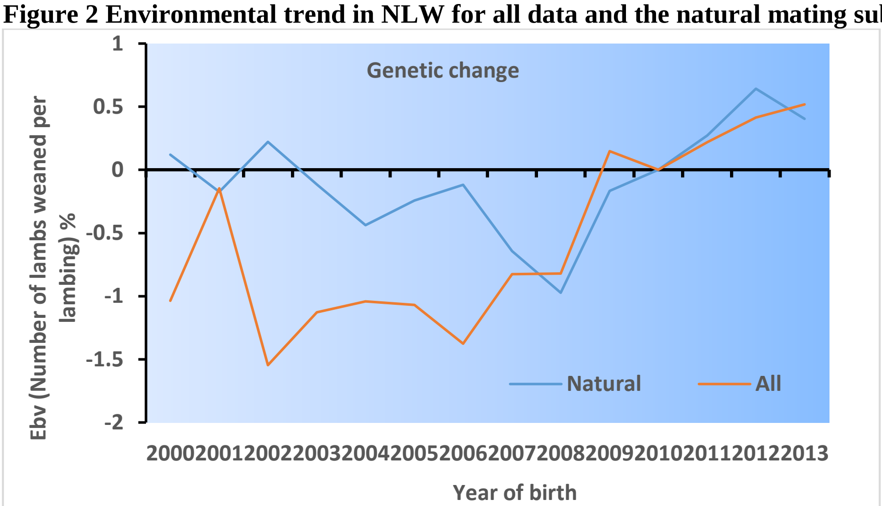

Figure 3 Genetic trend in NLW for all data and the natural mating subset.

DISCUSSION

Results for heritability are in agreement with literature (Safari *et al.* 2007). However, the higher estimates of heritability for the natural mating group of studs, needs further investigation when more data becomes available. The result of a lower level of management for natural mating studs was expected. However, a higher positive gradient for phenotypic change for studs making use of accelerated reproduction techniques was expected. NLW may be a useful selection especially when supported by genomic information (Daetwyler *et al.* 2014). Interim use of a repeatability model for routine evaluation is supported. Current results do not support the notion that the South African Dohne Merino industry is intensifying management for increased reproduction, which may sacrifice hardiness and adaptability.

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