

Genetic trends in South African terminal sire sheep breeds

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Abstract

Genetic trends were constructed for early growth traits in the Dormer and Ile de France terminal sire sheep breeds. The traits that were considered were birth weight, pre-weaning weight, weaning weight and post-weaning weight. However, pre-weaning weights were only available for the Ile de France breed and post-weaning weights were only available for the Dormer breed. Regressions of average annual breeding values on birth year indicated significant genetic gains in all early growth traits during the evaluation period. The average predicted direct breeding value of birth weight decreased by 0.055% per annum whereas weaning weight increased by 0.12% per annum and post-weaning weight improved by 0.32% per annum in the Dormer breed. The Ile de France registered an undesirable increase in the predicted direct breeding value of birth weight which amounted to 0.025% per annum. Predicted direct breeding values for pre-weaning weight increased at an annual rate of 0.23% and that of weaning weight by 1.21% per annum. Although adequate genetic variation for substantial genetic progress was available, only modest rates of progress were attained for all the traits in both breeds. The only possible exception was weaning weight in the Ile de France breed, which was improved at > 1% per annum. At least all changes were in the desired direction, barring the direct genetic trend for birth weight in the Ile de France breed. Breeders should be encouraged to record data consistently, as one of the major shortcomings in the data for both breeds were a lack of continuity in the submission of data to the NSIS. More informative analyses ought to be feasible if this requisite is met.

Keywords: Predicted breeding value, regression coefficient, evaluation, least square mean, significant.

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Introduction

The primary goal of animal breeders is to maximize the rate of genetic improvement through selection (Van Wyk, 1992). In meat sheep enterprises, this implies maximizing the genetic improvement of meat production. Sheep breeding enterprises must be evaluated on a regular basis to determine their effectiveness (Van Wyk *et al.*, 1993; Swanepoel, 2006). Genetic trends reflect the amount of genetic improvement (or lack thereof) in a population over time. It is generally accepted that accurate genetic parameters for a breed are required before changes are made to selection criteria. Selection on best linear unbiased prediction (BLUP) of breeding values obtained by Henderson's mixed model methodology is recommended for livestock improvement since the correlation between the predicted and the true breeding value is maximized (Olivier *et al.*, 1995). The difference in profitability of sheep breeds remains one of the most controversial issues among sheep producers (Snyman *et al.*, 1995). Farmers often change from one breed to the other mainly due to short-term financial reasons and fluctuations in wool and meat prices. Profitability in sheep production for meat depends to a great extent on lamb weight, therefore selection objectives invariably include this trait (Tosh & Kemp, 1994). Genetic improvement of livestock depends on well-defined breeding objectives, the estimation of genetic parameters and the accurate identification of the most suitable animals to be used for future breeding.

Genetic trends in South African terminal sire sheep flocks have not yet been reported. Knowledge of these is essential to effectively implement selection criteria. Against this background, the objectives of this study were to obtain estimated direct breeding values for early growth traits in the Dormer and Ile de France breeds and to use these breeding values to construct genetic trends over time.

Materials and Methods

Data pertaining to early live weight were sourced from the South African Dormer and Ile de France breeds as recorded from the National Small Stock Improvement Scheme database. In total, birth weight records numbered 11768 for the Dormer breed and 13951 for the Ile de France breeds. Weaning weight correspondingly amounted to 44776 and 5903 for the respective breeds. A total of 27269 pre-weaning live weights were recorded in the Ile de France breed only, while 7668 post-weaning weights were recorded in the Dormer breed only. The ranges of ages at which traits were recorded were uncharacteristically high, with some overlap between ages. The interval for acceptable ages was thus determined statistically. The univariate procedure in SAS was then utilized to determine the ranges of the pre-weaning age, weaning age as well as the post-weaning age. After elucidating the means and standard deviations, 95% confidence intervals were constructed. Only lambs with age records within the 95% confidence interval for the age associated with a specific weight were retained. When treated in this way, weaning age ranged from 74 to 126 days and post-weaning age from 127 to 399 days in the Dormer breed. Pre-weaning age accordingly ranged from 27 to 71 days and weaning age from 73 to 129 days in the Ile de France breed. After extensive editing, these data were subjected to analyses to assess environmental and genetic factors associated with the respective live weights (Zishiri, 2009).

Individual direct breeding values were derived for each trait by using the animal solutions generated from the output from the most appropriate single-trait animal model in ASREML (Gilmour *et al.*, 2002). These breeding values were averaged within birth years and used for the assessment of genetic trends, defined as the regression of average predicted breeding value on year of birth. Standard linear regression techniques were used to assess the genetic trends in both breeds over time. Trends were only constructed using direct breeding values of flocks that were consistently submitting information from the NSIS. It is crucial to explicitly report at this stage that genetic links across the flocks were commonly being broken due to random entrance into and exit from the scheme by individual producers. This resulted in few links being available between granddam-dam-offspring relations. This lack of adequate linkages compromised the ability to partition maternal effects accurately into m^2 and c^2 (Zishiri, 2009). As both breeds are considered as terminal sire breeds in the local sheep industry, this limitation is possibly not of utmost importance, as direct breeding values for growth are arguably the most important factor contributing to efficiency on the male side in terminal crossbreeding systems (Roux, 1992).

Results and Discussion

The regression coefficient of the average predicted breeding value for birth weight on birth year amounted to -0.0021 ± 0.001 kg per annum with a corresponding R^2 of 0.421 in the Dormer breed. This annual change amounted to a decrease of 0.055% per annum during the evaluation period when expressed relative to the overall mean. In contrast, the overall regression coefficient of amounted to 0.001 ± 0.0008 kg per annum in the Ile de France breed, indicating an average annual increase in breeding value of 0.025%. There is a paucity of information on comparable genetic trends in terminal sire sheep breeds. In contrast to the present study Van Wyk *et al.* (1993) reported an annual increase in birth weight of 0.023 kg per year in the Elsenburg Dormer stud, whilst Duguma (2001) also reported an increment in the mean direct breeding value for birth weight in the Tygerhoek Merino flock. Realised increases in birth weight could be undesirable because, if they are excessive, they may result in negative consequences such as difficulties in lambing, and resultant parturient deaths. The mean annual breeding values of pre-weaning weight in the Ile de France breed increased from -0.3636 to 0.1203 kg between 1990 and 2007. This increase translated to a gain of 0.23% per annum during the 17-year period of evaluation, which seems to be reasonable. The regression coefficient depicting the regression of averaged breeding values for weaning weight on birth year amounted to 0.0406 ± 0.01 kg per annum with an observed R^2 of 0.90 in the Dormer breed. Relative to the overall mean, this improvement amounted to 0.12% per annum (Figure 1). A direct genetic improvement of only 0.12% per annum in a terminal breed (where early growth should be maximized) is lower than the 1 - 2% which should be theoretically attainable. In contrast, averaged breeding values for weaning weight increased at a rate of 0.3445 ± 0.02 kg per annum in the Ile de France breed, which translated to a commendable 1.21% per annum. The regression coefficient for average post-weaning weight on birth year amounted to 1.0237 ± 0.300 kg per annum in the Dormer breed, with an R^2 of 0.414. The overall least square mean of post-weaning weight was 53.06 kg. The average predicted breeding values for post-weaning weight

was thus improved by 0.32% per annum. It was concluded that post-weaning weight exhibited substantial genetic improvement during the evaluation period in this breed.

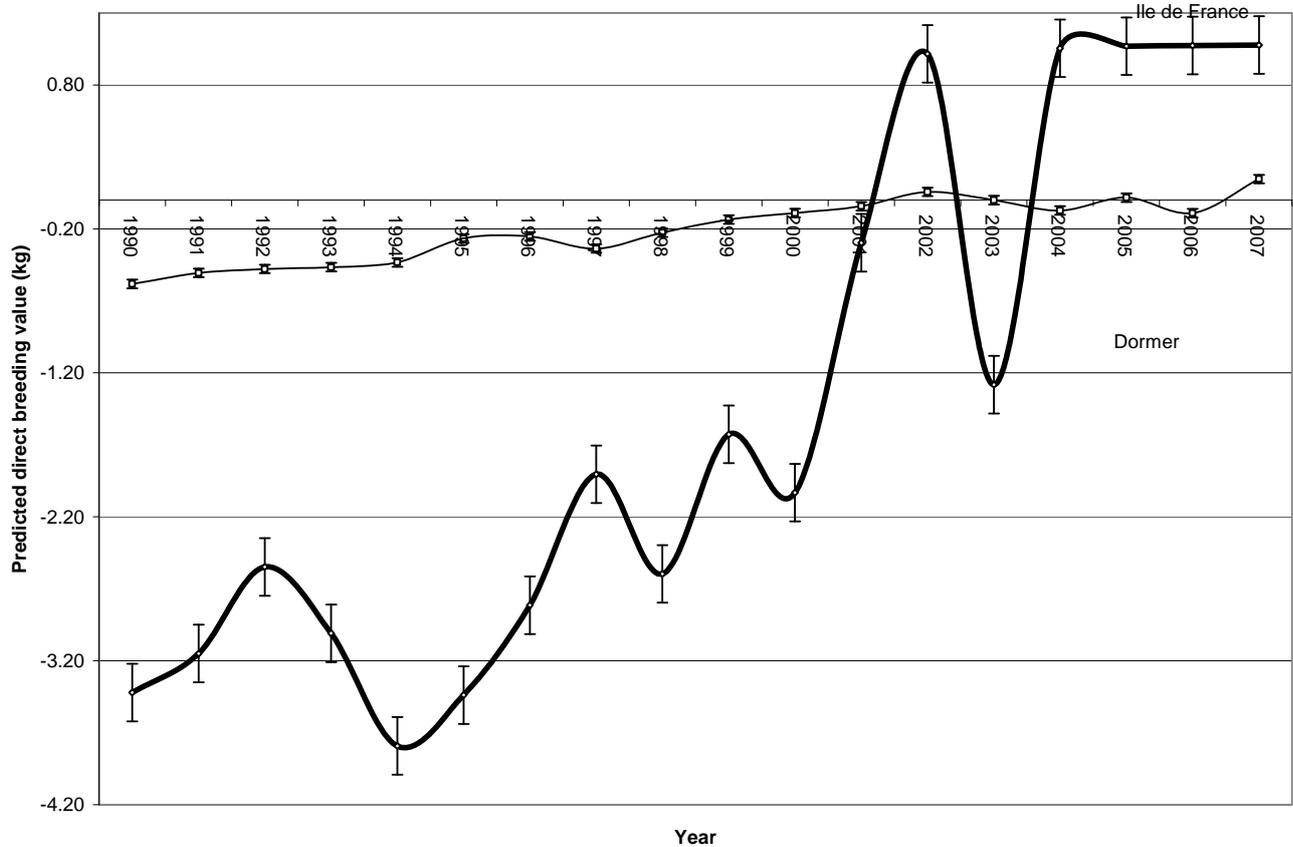


Figure 1 Mean annual predicted breeding values for weaning weight in the Dormer and Ile de France breeds. Annual means are accompanied by the relevant standard error.

In summary, attained genetic trends for both breeds are expressed as percentages of the overall means and depicted in Table 1. Previous genetic trends reported by Olivier *et al.* (2004) are provided for comparison where applicable. It is clear that undesirable responses in birth weight were limited in magnitude compared to the realized responses in early growth traits. Ideally the progeny of terminal sire breeds should be relatively small at birth, to ensure that smaller dam breeds (like the Merino) are still able to give birth without undue problems. However, fast post-natal growth should be strived for, to capitalize on advantages due to feeder-breeder dimorphism (Roux, 1992).

Table 1 Responses per annum to selection for early growth traits in South African terminal sire sheep breeds expressed as a percentage of the respective overall least-squares. Corresponding values reported by Olivier *et al.* (2004) in brackets where appropriate

	Birth weight	Pre-weaning weight	Weaning weight	Post-weaning weight
Dormer	-0.055%	-	+0.12% (0.22%)	+0.32%
Ile de France	+0.025%	+0.23% (0.12%)	+1.21%	-

Conclusions

The genetic trends obtained in the study indicated that significant and sustained genetic progress in the desired direction has been achieved in early growth traits in the Dormer and Ile de France breeds. However, it needs to be conceded that faster progress would theoretically be feasible, with the possible exception of weaning weight in the Ile de France breed. These results therefore provide an important perspective on the selection objectives of both breeds. Both breeds are well positioned as terminal sires in crossbreeding programs with the objective of prime lamb production, and potential exists to accelerate genetic gains in early growth in both breeds, thus enhancing their potential as terminal sire breeds. The attained genetic trends should be updated as additional data becomes available.

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