

THE EFFECT OF CULLING LAMBS AT WEANING ON ESTIMATED BREEDING VALUES OF PERFORMANCE TRAITS AT 15 MONTHS OF AGE OF A DOHNE MERINO STUD

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INTRODUCTION

Livestock selection practices are used to firstly identify animals that will become the sires and dams of the next generation and secondly to determine when an animal will be culled from the breeding population. The last step will therefore have an effect on how many offspring an animal will produce over its lifetime. The first step the aim is to select the best replacement animals according to predetermined selection objectives, while the second step aims to cull unproductive and old animals.

In order to have an effective selection program, it is important that producers have access to a complete and reliable dataset that consists of pedigree and production data. The accuracy, with which this information is recorded, cannot be over emphasised. Accuracy, in breeding terms, is defined as the strength of the relationship between true values and their predicted values for a specific trait. The higher the accuracy of a breeding value, the greater is the probability that the selected animals will be the best sires and dams.

The accuracy of breeding values are influenced by several factors such as the heritability, number of records, pedigree relationships, management of the animals, the accuracy of measurements and contemporary groups identification. The fact that the number of records has an influence on the accuracy implies that the higher the number of accurate records available, the higher the accuracy prediction will be of a specific breeding value (Bourdon, 1997).

However, the general practice within the wool sheep stud industry of South Africa is to cull lambs at weaning (approximately 4 months of age) in order to reduce the number of lambs that need to be reared under extensive farming conditions. Lambs with visual cull faults are normally culled, as well as lambs with below average weaning weight or weaning weight index. The general rule of thumb is that a minimum of 45% of the weaned ram lambs and a minimum of 75% of the weaned ewe lambs must undergo complete progeny testing (Olivier, 2016). Final selection on the remaining lambs are performed at approximately 15 months of age, which imply that due to the practice of culling, a large portion of the information for each lambing season is not available.

As suggested previously, this may possibly have a detrimental effect on the accuracy with which replacement animals are selected. The aim of this study was therefore to quantify the effect of culling of lambs at weaning on the estimated breeding values (EBV) of performance traits at 15 months of age of a Dohne Merino stud.

MATERIALS AND METHODS

Data collected on the Grootfontein Dohne Merino stud from 2001 to 2013 were used for this analysis. This stud is run on natural pastures at Grootfontein Agricultural Development Institute (GADI) near Middelburg (31°28'S, 25°1'E) in the north-eastern Karoo region of South Africa. GADI is located in the False Upper Karoo (Acocks, 1988) and has an average annual rainfall of 360 mm. The traits included in the analysis were 15-month body weight (BW), clean fleece weight (FW), fibre diameter (FD) and staple length (SL).

The complete dataset of the GADI Dohne Merino stud was used in this study, which include data from all the animals that are still alive at 15-month performance testing age. No animals are culled from the flock before final selection is done after the recording of the performance traits at 15 months of age. This is done to ensure that the dataset are not biased. For the purpose of this study, subsets of the data were created by deleting or including the pedigree of animals and their data. This was done to simulate different selection scenarios. The animals with cull faults at weaning, indicated by the weaning class symbol for Dohne Merino sheep, and below average weaning weights were culled from the complete dataset. The description of the data before and after culling was performed are summarised in Table 1.

Table 1. Data description before and after culling was performed

Traits	Without culling			With culling		
	Number of records	Mean	CV ¹ (%)	Number of records	Mean	CV (%)
Body weight (kg)	4218	48.95	20.58	2703	49.57	20.58
Fleece weight (kg)	4199	2.57	25.19	2691	2.64	24.40
Fibre diameter (µm)	4219	16.94	8.26	2705	17.01	8.16
Staple length (mm)	4226	83.18	21.41	2711	84.11	21.37

¹ – Coefficient of variation

Three different scenarios were evaluated in this study. The first scenario included the complete pedigree information available in the dataset, as well as all the data for 15-month body weight (BW), clean fleece weight (FW), fibre diameter (FD) and staple length (SL). This scenario represents the

situation where no culling is done at weaning. The second scenario included the complete pedigree and only data from ram lambs with a weaning weight index (WWI) of higher than 100 (approximately 50% of the ram lambs) and ewe lambs with a WWI of higher than 90 (approximately 75% of ewe lambs) were used. The third scenario was the same as the second scenario, except that the pedigree was limited to animals with data.

In order to quantify the effect of culling, the Spearman ranking correlation under the PROC CORR procedure of SAS (SAS, 2009) was used to estimate the correlations between the EBVs of the respective traits estimated for each scenario. The EBVs for BW, FW, FD and SL were estimated for the different scenarios using the ASREML3 program (Gilmour et al., 2009).

RESULTS AND DISCUSSION

The distribution of the percentage of progeny of selected or culled per ram were illustrated in Figure 1. The average percentage of progeny selected per ram for the simulation dataset was 64.6% and the standard deviation was 9.6%. This means that the proportion of progeny selected of 66% of the rams ranged from 65% to 74.2%. Furthermore, there were rams whose proportion progeny selected were more than 85%.

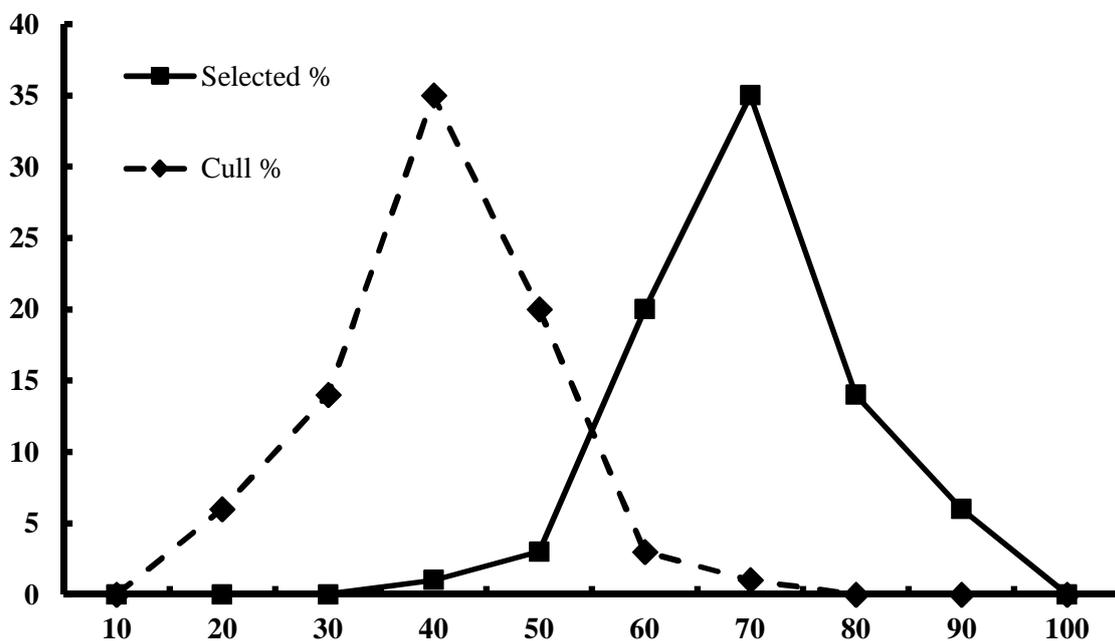


Figure 1. The distribution of the percentage of progeny selected or culled per ram

The range of the EBVs for the respective traits under the three scenarios are summarised in Table 2. It is evident from Table 2 that the EBV range for BW, FW and SL of Scenario 2 and 3 are similar, while it is also narrower than the range of Scenario 1. The decrease in the range that was observed in

Scenario 2 and 3 indicates that the difference among the estimates will become smaller. This might lead to the selection of replacement animals that would have not been considered for selection under Scenario 1. The consequence of this will be a decrease in the achievable genetic gain. The tendency was observed in fleece weight, as well as staple length. The EBV ranges for FD are similar in size between the three scenarios, but there is a tendency for the minimum and maximum values to increase from Scenario 1 to Scenario 3.

Table 2. Range of estimated breeding values (Min-Max)

Traits	Scenario 1	Scenario 2	Scenario 3
Body weight	-4.91 to 5.69	-3.48 to 2.99	-3.29 to 3.02
Fleece weight	-0.37 to 0.50	-0.27 to 0.39	-0.27 to 0.34
Fibre diameter	-3.10 to 2.12	-3.01 to 2.30	-2.71 to 2.48
Staple length	-11.98 to 15.29	-11.97 to 12.73	-11.8 to 13.13

The mean accuracies, as well as the accuracy range for the respective traits for each of the scenarios, are summarised in Table 3. It is evident from this table that the accuracies of Scenario 1 were higher compared to Scenario 2 and 3 for all the traits. This supports the statement of Bourdon (1997) that the availability of information has a definite effect on the accuracy of an EBV. The change in the EBV accuracies of BW and FW in this study was more profound.

Table 3. The accuracies of the EBV (Min-Max) of the respective traits for the three scenarios

Traits	Scenario 1	Scenario 2	Scenario 3
Body weight	63.93 (46.91-92.70)	52.38 (33.93-85.13)	51.20 (31.79-84.70)
Fleece weight	60.87 (42.30-91.50)	53.66 (2.60-87.12)	51.91 (18.42-87.08)
Fibre diameter	83.29 (78.12-97.12)	81.86 (66.32-96.03)	80.96 (65.58-96.09)
Staple length	69.49 (55.87-94.48)	66.28 (52.82-92.12)	65.70 (51.99-92.22)

The accuracy of Scenario 1 for body weight was 22% higher than that of Scenario 2 and the corresponding value for FW was 13%. The corresponding differences for FD and SL were 2% and 4% respectively. It is furthermore important to note that the inclusion of the pedigree information of animals with no production data led to a slight improvement in accuracies of EBV (Scenario 2 vs. Scenario 3).

The Spearman ranking correlations among the respective scenarios are summarised in Table 4. It is evident from this table that re-ranking did occur among all three scenarios for BW, FW, FD and SL, with FD being the least re-ranked. The biggest changes in the ranking according to the EBVs was observed in FW, even more so when the pedigree information was also omitted from the analysis. The culling and omission of pedigree information would also lead to changes in the ranking according to the EBVs for BW and SL. The inclusion of the pedigree information (Scenario 2) would lead to a more accurate ranking of the animals compared to Scenario 3, especially for FW.

Table 4. Spearman ranking correlations among the different scenarios

	Scenario 1			
	Body weight	Fleece weight	Fibre diameter	Staple length
Scenario 2	0.92	0.81	0.99	0.96
Scenario 3	0.88	0.64	0.97	0.93
	Scenario 2			
Scenario 3	0.98	0.73	0.98	0.97

It is evident from the results of this study that the EBVs of BW and FW will be more profoundly affected by the culling of lambs at weaning than FD and SL. The culling of poor performers will therefore generate a dataset that is biased as only better performing progeny of sires will have performance data. This can therefore lead to the over estimation of the EBV of an animal for a specific trait, because important pedigree and performance information of poor performing relatives was not included in the analysis.

The narrower distribution of the EBVs of Scenario 2 and 3 suggest that the EBVs of some animals will be overestimated while the EBVs of other animals will be under estimated. This means that animals might now be considered for selection that should not have been considered. This will have a detrimental effect on the genetic progress in a stud or flock as inferior animals will be used as replacement sires and dams.

CONCLUSIONS

It can be concluded from the results of this study that the culling of animals at weaning and the omission of the pedigree information of these animals will have a negative effect on the selection of replacement animals. However, the culling of surplus animals at weaning is an economic decision and the practice will therefore not change. Due to these reasons it is important that the pedigree information of the culled animals must be included in the estimation of EBVs for the production traits.

Producers should in the light of this situation ensure that when replacement animals are selected on EBVs for the respective production traits the accuracy of the EBVs are considered. The higher the accuracy, the less likely it is that the value will change drastically when more information becomes available.

The effect of culling should be investigated further in other resource flocks with complete datasets, as well as the possible effect on the national datasets for the respective traits. The possibility of including a corrective measure should also be investigated.

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