Selection for low faecal worm egg count in sheep resulted in an increase in additive genetic variance

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Background

Selection theory predicts that selection changes gene frequencies and that it can lead to an increase in homozygosity, which reduces the genetic variance.

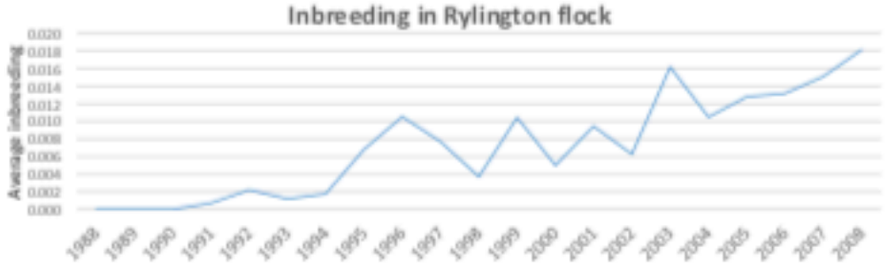
The Rylington Merino flock was established in 1987 from various sources in the winter rainfall region of Western Australia. Ninety donors each contributed 8 ewes whereas rams were sourced from different research flocks investigating the inheritance of worm resistance in sheep.

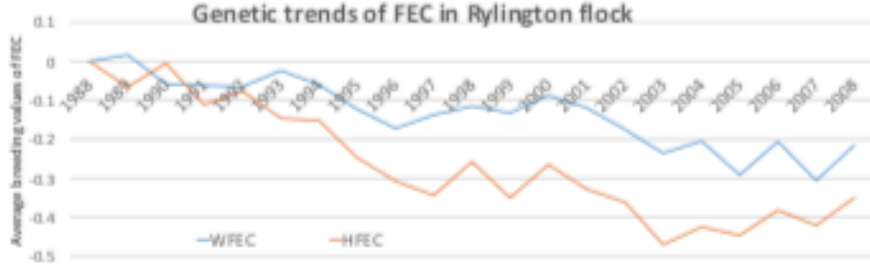
This study was carried out to determine whether selection for low faecal egg count (FEC) resulted in a change in the additive genetic variation (Va) and heritability of FEC in this flock.

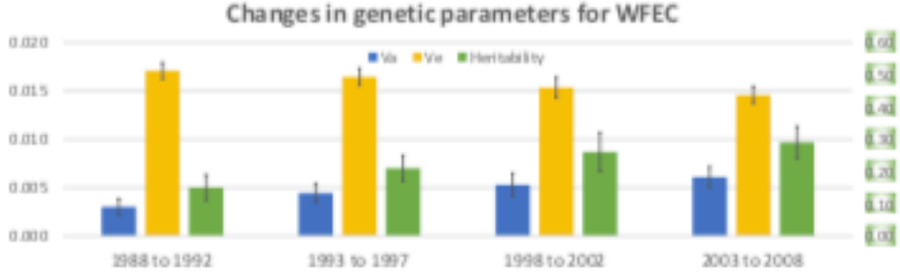
Material and methods

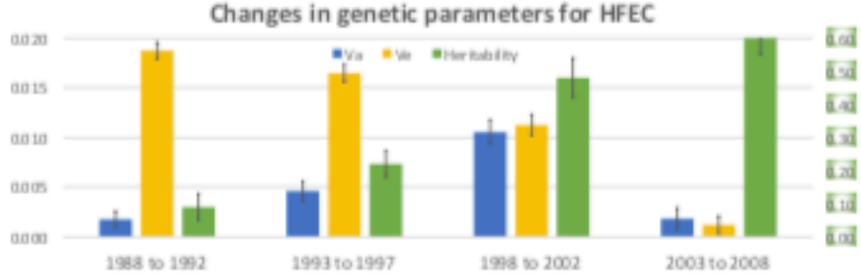
Within flock selection for low FEC, as in indicator trait of worm resistance, was carried out from 1988 to 2008 in this flock.

FEC was recorded at weaning (WFEC) and at hogget age (HFEC), and full pedigrees were available on all sheep. The dataset consisted of 13956 sheep born from 5129 dams mated to 254 sires. The data were subdivided in four time phases (5, 5, 5, and 6 year periods) and each phase was analysed separately with mixed model methodology using the same pedigree structure. The FEC data were standardised to have the same variance for each year and sex, and were square root transformed. ASREML was used to analyse the data fitting year, sex, birth type, age of the dam and all 2-way interactions as fixed effects in the model and animal as random effect. Breeding values and inbreeding were estimated for each sheep which were then averaged within birth year to obtain trends.









Conclusions

Selection for low FEC decreased FEC over time. However, during the last phase (2003-2008) genetic progress was lost in HFEC, most likely from the low Va. This appears to be caused by dry environmental conditions which reduced the worm challenge and resulted in low FEC.

Inbreeding increased slowly during the experiment. However, Va and consequently the heritability of FEC **increased** while selecting for low FEC, except in the 2003 to 2008 phase. This was most likely caused by an increase in Va and a decrease in environmental variation (Ve). Potential causes of this phenomenon could be

1. an increase in the frequency of rare worm resistance genes with moderate to large effects, and/or
2. an increase in sharing epistatic effects for FEC between parents and progeny.