

Quantification of breed composition: The power of genomic testing

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Every individual sheep in your flock has a story to tell, hidden in its DNA. The question is: Are you listening?

For generations, breeders have relied on pedigree records, performance, visual assessment and experience to make breeding decisions. While these are essential tools, they do not always reveal the complete genetic picture. Recording errors do occur, parentage may sometimes be uncertain, and animals with identical pedigrees can inherit very different combinations of genes from their parents. Two sheep may look alike but have completely different genetic backgrounds.

Today, genomic technology allows us to look directly at an animal's DNA – the genetic code that makes each animal unique. This provides valuable information that, when used correctly, can improve breeding decisions, strengthen breed integrity and add confidence when buying or selling animals. By analysing thousands of genetic markers, known as single-nucleotide polymorphisms (SNPs), distributed across the entire genome, genomics provides an independent assessment of the animal's genetic makeup.

Why test animals?

Whether you run a stud or a commercial flock, every breeding decision has an impact on the future of your flock. Selecting the right rams and replacement ewes determines which genetics remain in the flock for years to come. Genomic knowledge simply provides another piece of information to support these decisions.

Genomic testing can help you confirm parentage, gain insight into the genetic relatedness between animals, herds, and breeds, and avoid unwanted or detrimental mutations/diseases.

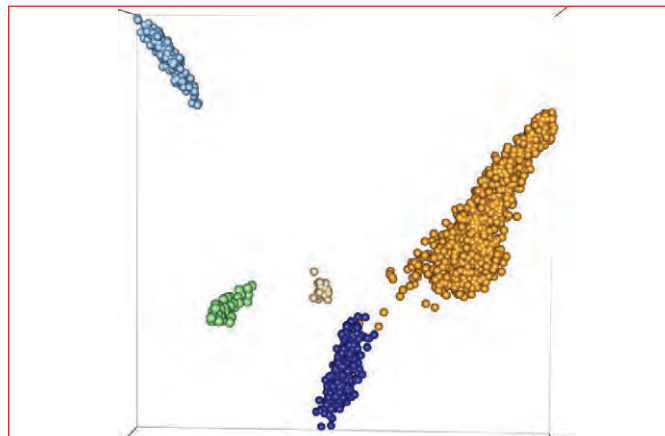
Introducing the GeneBox

Every breed has its own unique genetic fingerprint, just as every animal carries a unique DNA pattern inherited from its parents. Selective breeding over many generations has resulted in animals in the same breed sharing many common DNA characteristics. As a result, they naturally cluster together genetically. By comparing an animal's DNA code with a large reference population – animals whose breed composition has already been confirmed – it is possible to estimate the proportion of each breed present in its genetic make-up.

The reference population acts as a benchmark against which other animals are compared. The larger and more representative (diverse) the reference population, the more accurately breed composition can be estimated. The reference population is carefully assessed to ensure that each breed is represented by animals that truly reflect its genetic characteristics.

By combining information from all the SNP markers, the system can estimate an animal's breed composition. Another validation method is to use principal component analysis (PCA) visualised

Figure 1: SA Stud Book's 3D GeneBox.



The GeneBox depicts the genetic distances between animals (represented by a dot) and shows how an animal clusters within its breed (each colour represents a different breed). A more widely dispersed cluster indicates greater breed diversity, while a tight cluster indicates less genetic variation among individuals.

within a three-dimensional 'GeneBox'. The combination of an accurately established reference population, thousands of SNP markers, and advanced statistical analyses provides a powerful tool for breed composition. Genomic analyses examine the DNA itself to obtain an objective estimate of the genetic background, even when pedigree information is incomplete.

Participation in a GeneBox

As mentioned, breed composition, known as a 'Breed Key' at SA Stud Book, relies heavily on the reference population. A minimum of 100 genotyped animals per breed, representing multiple breeders, is required to start building an accurate GeneBox.

The genomic testing services provided through SA Stud Book are gaining momentum among small-stock breeders. Several breeds can already expect to benefit from inclusion in the GeneBox (Figure 1), including Merino, Dormer, Dorper, Dohne Merino, and SA Mutton Merino.

Other breeds can also become part of the GeneBox once a sufficient number of genotyped animals has been included in the reference population for that breed.

The sheep industry continues to evolve, and breeding decisions are becoming more data driven. The most successful breeders combine practical experience with objective information to make informed decisions that benefit their animals. Genomic testing does not replace good stockmanship. Every flock has a genetic story waiting to be discovered. With the SA Stud Book GeneBox and Breed Key, that story is only one DNA sample away. ^{SF}