The first article in a new series

The establishment of the National Deer Recording Scheme will, with time, improve the genetic merit of the national herd, by making possible the selection of more efficient animals. Some of the broad principles of genetic improvement have been described in 'The Deer Farmer' (Summer 1982-83, Autumn 1983 and Winter 1984).

This series, by Peter Fennessy and Peter Dratch, Invermay Agricultural Research Centre, will consider in more detail the problems of deer improvement: What is meant by improvement, and how it can be realised. Under discussion will be variation, the choice of traits for improvement through selection within a strain (e.g. within a herd of Red deer) and hybridisation between strains or species (e.g. Wapiti-Red crossing).

There will be reports on relevant deer studies both in New Zealand and around the world.

Throughout the series the authors hope to return to practical aspects of deer breeding, from group breeding schemes to sire selection and evaluation. Although the articles will concentrate on Red deer the principles of selection within a herd will also apply to Fallow deer.

Directions in deer breeding: Themes

THE SUCCESS of any programme of genetic improvement depends foremost on defining the trait (i.e. the character) we want to improve. Second, improvement entails measuring, by some recording scheme, the amount of variation for this character which exists in the animals available for breeding.

The character to improve is clearly defined at the winning post with thoroughbred horses. Similarly, wool weight, fertility and weight gain have been useful objectives in sheep breeding. However, market demands change, (as this year's deer velvet prices will no doubt demonstrate); consequently the production of large lean lambs has become a top priority in the sheep industry.

As Red deer represent over 80 per cent of the deer behind fences in New Zealand, they must form the basis of any genetic improvement programme with widespread application. What productive character do we want to improve within these animals?

A great deal of emphasis has gone into improving antler weights in Red deer, and this has been the major rationale for recent Wapiti importations from Canada. However, any character which is determined at least in part by the animal's genetic make-up and shows variation within a breeding group can be selected for. Some deer characters which suggest themselves are:

- Velvet antler weight
- Velvet antler shape
- Weight gain, or weight for age
- Carcase composition, or lean/fat ratio
- Calving date
- Twinning
- East of handling
- Disease resistance
- Temperature tolerance
- Ease of calving
- Mothering ability

In any selection programme, it is the genetic variation within the population which provides the raw material for genetic selection: While it might be great to get a third antler sprouting from the cervid snout, it is simply not possible as the genetic variation for triple antlers is just not there. Particularly where selection is within strains or breeds, the traits selected for are usually distinguished by little variation in relation to the average of the herd as a whole. This is especially true of social species, like Red deer.

Returning to the example of sheep, another social ruminant, it would be rare to find a ram with twice the average fleece weight. Though the amount of variation for fleece weight is fairly low, this is not to imply that genetic improvement is not possible; it is both possible and practical as has been shown in both research and commercial flocks. Similar improvement through selection has been demonstrated for velvet antler weight in Red deer (see Fennessy, 'The Deer Farmer', Summer 1982-83).

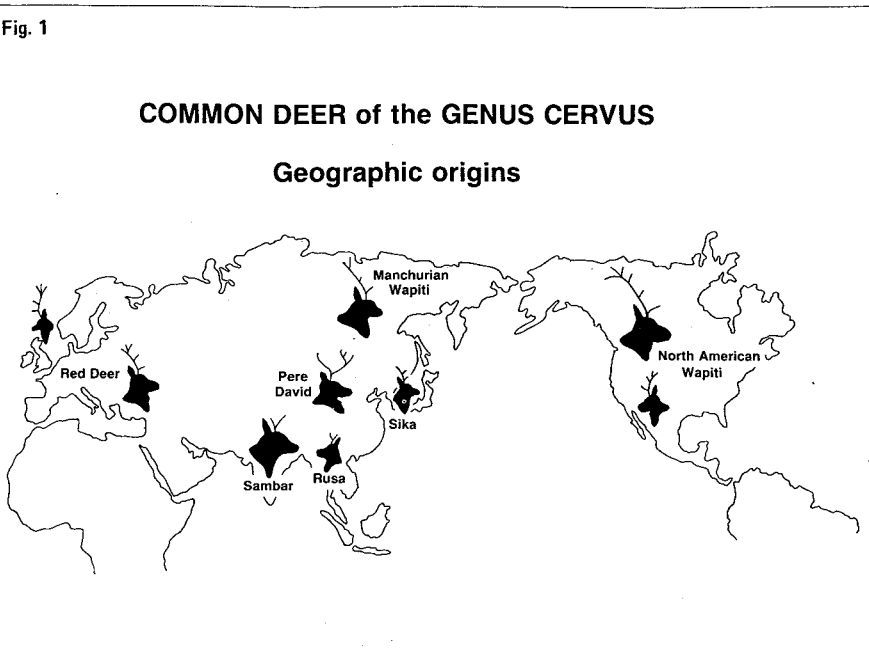
Variation

The actual amount of variation in a population for a character is expressed by the standard deviation as shown in Fig. 2. This concept is critical to genetic improvement, and it is only obtained by measuring and recording all of the animals in the herd for the valued character. This is also where the National Deer Recording Scheme has its place, in identifying – for better or worse – just how special that super stag is relative to the other stags in the herd or other stags used for breeding.

The sheep industry is now assessing the usefulness of selection for a range of characters compared with selection for single characters for the genetic improvement now needed. In a flooded Asian antler market, it is also likely that priorities will have to be sorted

The natural distribution of the species of deer which may hybridise with Red deer. The silhouettes indicate the approximate relative sizes of these deer.

Fig. 1



out by the deer industry. Specialist breeding for velvet antler is on the horizon, and non-correlated characters (those traits which do not accompany large velvet antler traits) will be sacrificed in these herds.

What makes deer unique?

Although the situation with selection and breeding of deer has many similarities with that of genetic improvement in sheep, horses and cattle, there is one crucial difference: With Red deer, there are several species of deer that will hybridise and produce fertile offspring.

To take an extreme example, the adult Japanese Sika female weighs about 50 kg whereas the adult Roosevelt Wapiti female from North America weighs about 300 kg, a six-fold difference in size under apparently similar environmental conditions. This difference is genetic and no amount of feed or labour in selection will produce a Sika female of 300 kg.

Yet the genetic differences between Sika and Wapiti are not a sufficient barrier to prevent them from producing fertile offspring, although the mechanics of such a mating and calving would be extremely difficult for those concerned, as Wapiti and Sika are fairly well genetically isolated. However from the deer farmer's point of view, if genetic improvement is the goal, Sika may be regarded as small Red deer and Wapiti as large Red deer. The mating of imported Canadian Wapiti bulls to New Zealand Red hinds is a similar though much less dramatic case.

Thus, as well as selection within the Red deer herd, we also have the opportunity for hybridisation between deer species, whether this be with New Zealand Wapiti which have already acclimatised and hybridised or with some of the more exotic imported deer. Table 1 lists a number of species which have hybridised or are likely to hybridise with Red deer in a farmed situation. The accompanying map, Fig. 1, shows the distribution of these species, along with an indication of the size variation which already exists in European Red deer.

The concept of genetic distance (or genetic isolation) is important to understand in considering hybridisation. Genetic distance is a measure of the degree of relatedness of two individuals or two groups. Put simply there is less genetic distance between

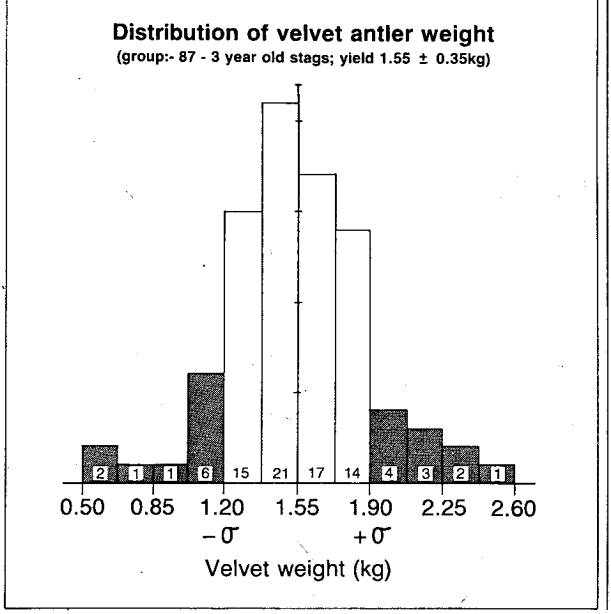
Table 1: Species of deer which may hybridise.

	Female body weight (kg)
Red deer	80-140
North American Wapiti	140-300
Sambar	120-140
Rusa	50-70
Sika	40-60
Pere David	120-140

▷

Distribution of velvet antler weight in a herd of 87, 3 year old Red stags. The mean yield was 1.55 kg with a standard deviation (σ) of ± 0.35 kg; i.e. two-thirds of the stags would have yields between 1.20 and 1.90 kg, 1 standard deviation either side of the mean. On the other hand the top 2 per cent of stags would be expected to have yields of more than 2.25 kg – in this herd three of the 87 actually achieved this.

Fig. 2



two brothers than between two second cousins.

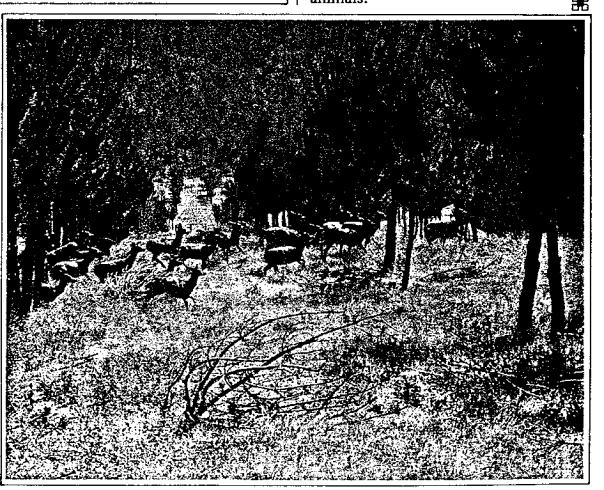
Two cautionary comments should be added to the hybridisation discussion. The greater the genetic distance between the potential pair, the greater the husbandry skills that will be required to successfully breed them. Some of those skills will no doubt be acquired by trial and error, but the highest priority must be given to the welfare of individual animals. This is not only humane but compelling, considering new venison markets.

Second, hybridisation for rapid genetic progress in a highly valued character does not obviate the need for selection within the new herd but only postpones it. Rigorous recording in the hybrid herd is vital, particularly if we are to identify any genetic costs in hybridising for a particular character.

There is enormous scope for genetic improvement within deer. Largely because of the value of velvet antler, most of the emphasis up to now has been put on bigger animals. Whether bigger can be equated with better in deer will be the subject of an article to follow.

Through selection and hybridisation, earlier calving and twinning are now being explored as new avenues of genetic progress. The bright future of the deer industry is not only reflected in staggering prices at auction (are not businessmen selected by their ability to identify tax deductions?) but it is bolstered by the vast genetic variation and potential of these animals.

From the deer farmer's point of view, if genetic improvement is the goal, Sika may be regarded as small Red deer and Wapiti as large Red deer. Thus, as well as selection within the Red deer herd, we also have the opportunity for hybridisation between deer species.



Sika deer on Lochinver Station