Selection criteria –what to record

The first article in this series, by Peter Fennessy, Invermay Agricultural Research Centre, was published in issue 13 of The Deer Farmer. It outlined the basic principles of genetic selection in Red deer.

In this article, the criteria to record will be explained. John Cowie, a deer farmer at Limehills in Southland, has been recording the performance of the animals in his herd for the past few years and the data he has collected has been a valuable resource in preparing this article.

Red stags in velvet.
Good velvet-producing stags can be selected on the basis of 2-year velvet weights with a high degree of accuracy.

Selecting for velvet antler yields

AVERAGE VELVET antler yields, by age, for Red stags on three farms, are given in Table 1. Yields increase with age from two to five years; a limited amount of information suggests that velvet weights reach their maximum at five to seven years.

The potential for increasing velvet yield by selection was considered in the last issue, when explaining selection principles. However, two further aspects must be mentioned.

The first is that, in general, heavier stags tend to produce higher yields of velvet antler. This is shown, for a group of 22 two-year-old stags, in Figure 1. However, despite the general relationship, there is still considerable variation around the regression line. Therefore selection of deer on the basis of weight, would be expected to also result in an associated improvement in velvet antler production. However the rate of progress in increasing velvet antler weight, by selection for velvet weight itself, would be faster than if selection was on the basis of liveweight. These two types of selection are known as direct and indirect, respectively.

Table 1:
Mean yields of velvet antler (kg ± standard deviation) for groups of Red deer stags on three farms (numbers in brackets)

Age	Farm A	Farm B	Farm C
2	1.23 ± 0.35 (40)	1.01 ± 0.26 (56)	–
3	1.55 ± 0.35 (87)	1.58 ± 0.30 (160)	–
4	–	2.02 ± 0.32 (153)	1.82 ± 0.35 (92)
5	–	2.12 ± 0.32 (84)	2.16 ± 0.38 (99)

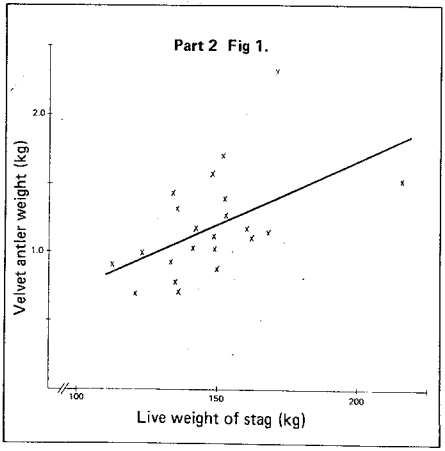


Fig. 1.
Relationship between velvet antler weight (A) and subsequent March liveweight (LW) for a group of two-year-old stags. Velvet antler was harvested at c. 60 days after casting: Equation (A = 0.0092 LW – 0.18; r = 0.53**, RSD ± .32 kg; n = 22). ▶

The second facet to consider is selection on the basis of two-year-old velvet weight. The analysis of a number of sets of data has indicated that velvet weight of a stag as a two-year-old is a good indicator of its subsequent velvet production. In other words, stags will tend to maintain their relative position, in terms of velvet weight, within their own age group from year to year. Good velvet-producing stags can therefore be selected, with a good deal of accuracy, on the basis of their two-year-old velvet weight.

Practical considerations on farms may, however, mean that velvet antler from two-year-olds is not all harvested at the same stage of growth. Two-year-olds are probably run in for harvest on only one or two occasions. Consequently there is considerable variability in the stage of growth within the group of stags harvested at the same time.

As a result, stags which are harvested at a relatively early stage of growth will be penalised in comparison with stags cut at a later stage. One means of adjusting for the stage of growth, or the length of the growing period (casting of old antler stubs to harvest), is to record the dates of both casting and harvest for the two-year-olds. The yield may then be corrected to a standard "60 day weight", using the multiplying factors given in Table 2. At present these are the best adjustment factors we have, although work in progress may result in a revision of these.

Table 2:
Adjustment factors for velvet growth for two-year-old stags

Growing period (Casting to harvest)	Adjustment factor
40 days	1.9
45	1.6
50	1.3
55	1.1
60	1.0
65	0.9

Selecting for growth rate

In a deer farming system producing venison, the obvious area in which to apply scientific principles of animal breeding is in selection for growth rate or weight-for-age. The objective is to produce deer which attain the optimal slaughter weight at a younger age, or which produce heavier carcases at the same age, but without the deposition of excess fat.

At this stage in the development of the deer industry it appears that most stags will be slaughtered at 14 to 17 or 24 to 27 months of age. Therefore, any selection and breeding programme would have as the major objective an increase in weight at these ages. Although we have no direct information from controlled genetic experiments, there is much circumstantial evidence that the heritability of growth rate or weight-for-age in Red deer is high, and will respond rapidly to selection.

From birth to maturity there are three periods in the life of the deer when growth potential is high, namely:

- The first six months of life, mainly the milk-feeding period.
- The yearling stage from nine to 15 months.
- The two-year-old stage from 21 to 27 months, which really applies to stags only.

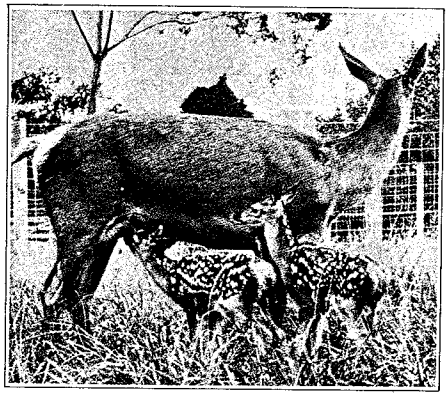
These periods of high growth potential are important, since genetic differences in growth rate are likely to be most apparent when actual growth rates are high.

The first six months

The milk-feeding period is a critical time in the life of the young deer, with the milk yield of the hind having a major impact on the weight of the calf at weaning. Analysis of data from the Cowie herd, where most hind-calf pairs were identified for the two calving seasons 1979/80 and 1980/81, indicated that the repeatability of mothering performance of a hind was high.

The data for 24 hinds is shown in Figure 2. The deviations have been adjusted for the sex of the calf, the age of the hind, and the sire of the calf; no attempt was made to adjust for the date of birth, but only calves born in November and December were included in the analysis. (1) The calves were weaned in May at about six months of age.

Red hind suckling her fawn.
Repeatability of mothering ability is very high.



The correlation coefficient of 0.73 is high, and indicates that there was a very strong tendency for those hinds which reared the heavier calves in 1979/80, to also rear the heavier calves in 1980/81. The circled points identify the two best hinds whose progeny were well above average in each year.

Having found that hinds tend to retain their position in the herd between years, the next question relates to the performance of their daughters when they subsequently join the herd.

Data is now available for 23 two-year-old hinds who produced their first calf in December, 1980 or 1981. The results (Table 3) are very encouraging, and suggest that considerable progress can be made by hind selection to improve weaning weight. In this table the hinds have been divided into three groups according to their own rating

1) The adjustment factors were derived from the herd mean values, the weaning weight of each calf being adjusted to that of a male calf out of a mature hind of three years or older. The approximate adjustment factors were: x 1.2 for a female calf from a two-year-old hind; x 1.1 for a female calf from a mature hind; x 1.1 for a male calf from a two-year-old hind.

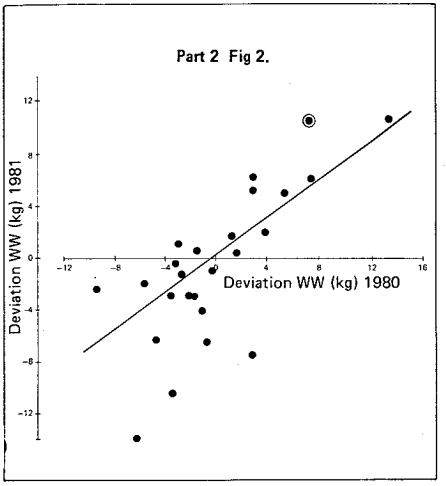


Fig. 2.
Relationship between deviations in weaning weight (DEV. WW) for the progeny of 25 hinds in two consecutive years. The circled point* indicates a hind whose progeny were 7 kg and 10.5 kg better than average in 1980 and 1981 respectively.

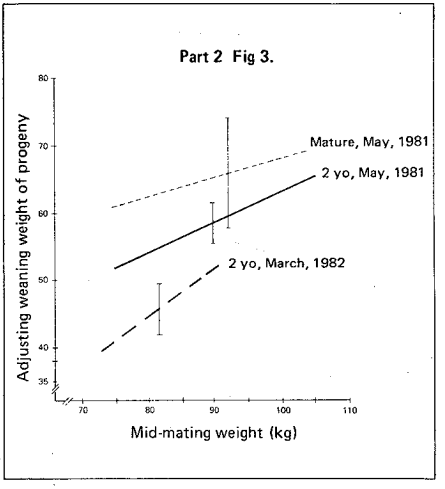


Fig. 3.
Relationship between adjusted weaning weight of a calf and mating weight of its dam at the time of conception. The bars I indicate the standard deviation.

.....mature hinds, weight in May 1980, calves weaned in May 1981, n = 43, r = 0.54**

.....2-year-old hinds, weight in May 1980, calves weaned in May 1981, n = 15, r = 0.64**

.....2-year-old hinds, weight in May 1981, calves weaned in March 1982, n = 15, r = 0.64**

as dams, and are presented with the mean rating values for their daughters as dams. An explanation of this data is as follows: the average hind in the top group weaned calves which were 4.5 kg heavier than average over two years; as a two-year-old her daughter reared a calf which was 1.4 kg heavier than average.

Although this data indicates a real relationship, not all is of genetic origin – some of the relationship is due to the fact that the same calves which contribute to the hind's rating are the very animals which subsequently produce calves of their own. This is important, since the heavier hinds at first mating tend to wean the heavier calves as two-year-olds.

Table 3:
Weaning weight deviations for hinds as dams (the mean of two years data), and their daughters as dams calving as two-year-olds

Hind performance		Daughter performance
Group (n)	Deviation (kg)	Deviation (kg)
High (8)	4.5	1.4
Medium (7)	0.6	0
Low (8)	−5.0	−1.4

Table 4:
Adjusted weaning weights for calves by different sires

Sire	Weaning weight Date		
	May 12, 1980	May 5, 1981	March 15, 1982
A	61.2 (26)	–	–
B	61.1 (23)	57.9 (37)	50.3 (20)
C	–	64.4 (19)	52.3 (19)
D	–	–	50.7 (15)

The relationship between weaning weight of a calf, and its dam's mating weight, is shown in Figure 3 for two year's data. Another point to consider here is the relationship between weaning weight and subsequent weight-gain to 16 months of age. The analysis of the Cowie data indicates that the heavier calves at weaning tend to have slightly faster growth rates subsequently.

Overall, the analysis of these records suggest that in a comparison of two hind calves, an 8 kg difference at weaning will increase slightly to about 10 kg at mating, and the difference in weaning weights of the progeny of this first mating will be about 6 kg.

The comparison of the weights of progeny from two-year-old and older hinds in Fig. 4, is very interesting, in that even with hinds of the same weight, the progeny of the older hinds were about 6 kg (or 12 per cent) heavier than those from younger hinds. Therefore this strong relationship between the performance of a hind and its daughters indicates that significant progress can be made through hind selection.

The major objective in identification of hind-calf pairs, and the recording of weaning weights, is the identification of the best hinds. Inferior hinds can be culled, thus improving the quality of the breeding herd. Also, replacement hinds can be selected as progeny of the best hinds.

▶ Recording of weaning weights can also provide valuable information on the sire. For example, John Cowie used four sires over a period of three years and the adjusted weaning weights are given in Table 4. The most interesting point to note is the weight difference between the progeny of sires B and C in 1980 and 1981. The superiority for the progeny of sire C was about 11 per cent in the 1980-born calves weaned post-rut, and 4 per cent in the 1981-born calves weaned pre-rut.

The yearling stage

Very high rates of growth are possible for deer during the period from nine to 15-months of age. This is the time of opportunity for the farmer, when good feeding of these young stock will result in better animals at 15 months. By 15 months hinds have reached about 75 per cent of their mature bodyweight, and stags about 55 per cent.

High rates of gain are evident for the deer in John Cowie's herd (see Table 5). Also apparent is the considerable growth rate superiority of the progeny of sire C over this period. This difference provides an indication of the genetic influence on the rate of gain. Some Invermay experiments, where stags have been fed a high-quality feed to appetite indoors in individual pens (thus removing the effects of competition between animals), also illustrate this point (Fig. 4). A 3 kg (7 per cent) difference between the progeny of the two sires at six months of age, had increased to 18 kg (20 per cent) at 15 months, and to 25 kg (23 per cent) at 24 months.

Clearly there are differences between sires in the mean growth rates of their progeny. However, there are also large differences in growth rate among the progeny of the same sire. For example, the heaviest stag by sire C at Invermay, was 126 kg at 15 months, whereas the lightest was 97 kg.

Table 5:
Weight gains from weaning to 16 months (hinds) or to 14 months (stags) for the progeny of the different sires (± standard deviation).

	1979 born	1980 born	
	Hinds	Hinds	Stags
A	26.3 ± 2.8 (14)	–	–
B	25.6 ± 3.9 (15)	29.1 ± 4.1 (28)	43.8 ± 4.6 (11)
C	–	35.7 ± 4.9 (8)	49.4 ± 4.7 (13)

The aim of a selection programme is to exploit such differences to improve the quality of the deer herds. At this stage no estimates of the heritability of weight-gain or weight-for-age are available for deer. However, in sheep and cattle the heritability of comparable weight traits is about 0.4, which means that about 40 per cent of the variation in weight (i.e. 40 per cent of the difference from the mean) is of genetic origin.

The two-year-old stage

For many deer farmers there may be advantage in retaining the majority of their 15-month-old stags until velvetting as two-year-olds. A later weighing at about two years will provide a further indication of growth potential, although it appears that rankings at 25 to 26 months are similar to those at 15 months.

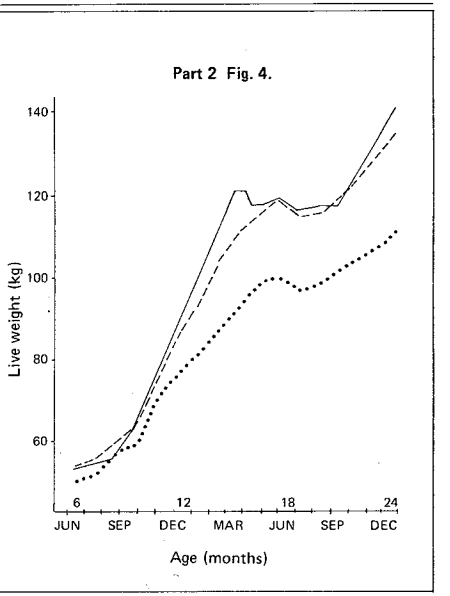


Fig. 4.
Mean liveweights for groups of stags individually fed a high-quality ad lib diet, indoors, from nine to 24 months of age (.....mean of six stags, progeny of two sires, A and B, in 1978–79; .....mean of 10 stags, progeny of sire C in 1979–80; .....mean of six stags, progeny of sire D in 1979–80).

Summary

Having outlined the principles of genetics involved in a herd improvement programme, and having identified the possibilities for improvement through selection, the important criteria to record for both hinds and stags is as follows:

- sire (and dam)
- weaning weight
- 15-month weight

And, for two-year-old stags:

- weight (at 25 to 27 months),
- velvet weight.

Many other sorts of potentially-useful information, such as birth date, birth weight, weights at six, nine and 12 months, may also be collected. However, those listed above are the most helpful.

Acknowledgements
I wish to thank Barry Butler, FAO (An. Hus.) with the MAF in Dunedin, for his helpful comments on these articles, and also the farmers who provided the information: John Cowie, Mark Acland, Bernard Pinney and Tim Wallis.