IMPROVING YOUR DEER HERD

GENETIC SELECTION ~~AND HERD IMPROVEMENT~~

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SUMMARY

Any programme of genetic improvement is primarily dependent on specifying the objectives. It is then a matter of choosing an appropriate character which is measurable and which will respond to selection.

The selection objective must be market related though it is recognised that genetic improvement is a long term investment and this can be difficult. Overall an appropriate objective is to improve the efficiency of conversion of grass to meat. In deer this probably entails selection for weight or growth rate.

The requirements for a successful scheme of genetic improvement include recording the pedigree of the animals and appropriate weights at different stages of the growth cycle. Since genetic improvement is a long term investment, now is the time to start, bearing in mind, of course, that genetic improvement is the step to be taken after you have the basics of farm management right.

INTRODUCTION

Modifying the genetics of farmed or domestic animals has been a feature of the development of many cultures over the past few thousand years. Hence we now have Great Danes and Daschunds, Merinos and Coopworths, Thoroughbreds and Clydesdales. If all this history teaches us one thing it is simply that where there is a clear objective and animals are selected on the basis of a clearly defined objective performance, then the results are spectacular. The thoroughbred is a superb example. However, where the objectives are less clear and based on opinions, then the results are much less satisfactory. An example is selection based on the opinion that sheep with woolly heads must be growing more wool overall. It would be far more profitable to actually weigh and record the fleece weights. Therefore the first point is to have a clear, measurable objective.

The second point is that the character you're interested in changing must be both heritable and vary within the population. By being heritable is meant that it be passed from parents to offspring at least in part. As well there must be variation within the population; eg, you cannot select for a third antler on the snout of a deer because this sort of genetic variation is not present in the population. Therefore if a character is measurable, heritable and variable then it is possible to make considerable progress by direct selection for the character you want to improve. So if you are really interested in breeding stags for bigger antlers, then select for antler size. This is so even though antler size and body size are correlated - bigger, heavier stags on average have bigger antlers. Progress in improving antler size will be faster when selection is based on antlers rather than on body size.

The point about correlated characters raises the next issue, namely to beware of the apparently correlated responses. These are the will o' the wisp effects which are here today and gone tomorrow. There is no ready example with deer but there is with sheep. In New Zealand, there is considerable interest in breeding leaner, meatier sheep. In some research flocks, there is a correlation between leanness and fecundity (lambs born per ewe) in that sheep from lean lines have more lambs and sheep from high fecundity lines are leaner. However, this association is not absolute - there are high fecundity lines of sheep which are not leaner. Therefore if you want leaner sheep, then select for leanness, not fecundity.

It will be apparent from this discussion, that the real problems come when the character you are interested in is not readily measurable. Carcass fatness and killing out percentage are two examples. In these cases there is no alternative but to use indirect selection; that is to select for some character which is associated with the desired character. Alternatively the breeder could progeny test stags by single sire mating them to groups of hinds and comparing the progeny at slaughter.

OBJECTIVES

Defining the objectives clearly and simply is the most important step in setting up a programme of genetic improvement. While the principle objective of selection and breeding is to improve the profitability of an enterprise, such an objective is too imprecise to be useful. If the bottom line objective is profitability, then we have to produce something for which other people will pay a premium or we have to produce it more efficiently.

Objectives must be market related. However a programme of genetic improvement in deer is a long term investment, and anybody who has attempted to make long term market predictions about any product will appreciate the enormous difficulties that this entails. However we have to make some attempts - eg, it is a good bet that the demand for lean meat will be much higher than that for fat meat but when it comes to a decision between red meat and white meat or between meat and vegetable protein, the situation becomes more difficult. Here it is the customers perception that is all important, which highlights the importance of considering the market base for a product and the commitment of the marketers to devise profitable ways of selling the product.

If the real aim is to improve efficiency, then there are obvious problems. Efficiency is something which means different things to different people and it can be very difficult to measure. My own definition is:

$$\frac{\text{Product output}}{\text{Food intake}} = \text{Efficiency}$$

In this definition, an estimate of food intake is required. Under practical grazing conditions, this is virtually impossible and therefore indirect estimates of efficiency are required.

EFFICIENCY

For this paper, we will assume that the objective is to genetically improve the efficiency of meat production from deer. The next step then is to identify the characters or traits to be selected for. At this point, it is useful to look at the readily measurable productive characters likely to influence efficiency.

It is a fact of life that bigger animals are metabolically more efficient. For example, a rat must eat more each day for its weight than a horse, simple because for its weight, the rat has a greater surface area and it is this surface area which is responsible for losing heat to the environment. In practice this means that a 200 kg deer would lose heat at only 2.8 times the rate of a 50 kg deer even though it is four times the weight (Table 1). Clearly this has repercussions in terms of the amount of feed required to maintain an animal. However, it is obvious that size isn't everything. Even among the red deer family, there are small sika in one environment and giant wapiti in another.

TABLE 1: Relativities between weight and metabolic rate

Weight (kg)	Relative weight	Relative metabolic rate
50	1.0	1.0
100	2.0	1.7
200	4.0	2.8
400	8.0	4.8

The difference in maintenance requirements (a function of the metabolic rate) means that the larger, heavier animal is more efficient than a smaller animal, all other factors being equal: however, in life all other things are seldom equal and therefore a thorough examination of each situation is necessary. For example, a female of 50 kg, which produces twins each year which reach a slaughter weight of 40 kg in 6 months, could be up to twice as efficient in terms of meat produced per unit of feed as a 500 kg female producing one offspring per year which reached 400 kg at 2 years of age. In addition to the reproductive rate and the relative growth rates of the offspring there are several other factors which need to be considered in comparisons of efficiency. These include productive life, ease of management, susceptibility to disease and animal health costs and the requirements and costs of supplementary feed. Some estimates of the impact of changes in some of these factors on efficiency have been made (Table 2).

TABLE 2: Factors affecting efficiency of meat production in a herd of red deer, the expected response in efficiency to changes in the factor, and the possible means of changing the factor (Fennessy 1982)

% change in the factor	% change in efficiency	Means of changing the factor
10% in weight for age of the whole herd	2	Selection within a herd or strain; change of strain/ subspecies (eg red deer to wapiti)
10% in weight of slaughter stock at 2.1 years	4	Hybridisation (eg wapiti X red deer females); selection; management-altering calving season
10% in herd weaning rate (calves weaned per 100 hinds to stag)	6	Management-nutrition; survival; selection for twinning
1% in herd death rate	2	Management and disease control; selection

From Table 2, it is apparent that there are numerous possible approaches to improving efficiency. In some cases, changes in management practice will be far more effective than any gradiose scheme of genetic improvement. For example, a better quality fence around a calving paddock can produce more dramatic effects on efficiency and profitability than 20 years of selection and breeding. This, of course highlights the fact that genetic improvement is the approach you take after you have got the basics of management right.

Practically, therefore, the most obvious way to breed a more efficient animal is through selection for weight. However this is not all straightforward. Selection for weight alone at any age will tend to result in an increase in overall mature size. Consequently the average weight for the whole herd will increase. Even so it may be possible to select for an improved early growth rate without having a major influence on mature size. One possible way to achieve this is to make some allowance for the rate of growth of an animal relative to its parents. For example in comparing two daughters of the one sire in the same mob but out of different hinds, the one that at 15 months of age, reaches 90% of its dam's mature weight is likely to be superior to that which reaches only 70% of its dam's weight at the same age.

PATTERN OF GROWTH

Having concluded that the most practical approach to improving efficiency in a deer herd is to select for weight it is necessary to look at the usual pattern of growth in the red deer. The growth pattern to 15 months of age is characterised by several phases:

- intrauterine growth reflected in birth weight
- growth on milk reflected in weight at about 3-4 months
- growth during the autumn at 4-6 months of age (post-weaning)
- growth during the first winter from 6-9 months
- growth during spring and summer from 9-15 months

Thereafter for hinds, the growth pattern is largely a function of their reproductive status (and the season of the year) and of course the quantity and quality of feed offered. Under normal farm conditions, though, hinds will continue to gain some weight each year to reach a mature weight at about 4-6 years of age. Having attained puberty stags also develop an annual cycle of weight change, although this is usually very mild in the rising 2 year old stag. From 15-21 months (rut and winter), the young stag will maintain weight or lose very little weight if fed to appetite, while from 21-27 months (spring-summer), growth is rapid. The demands of the hormonal changes through the annual reproductive cycle then take over, characterised by low feed intakes and large weight losses over the rut followed by weight maintenance during the winter. Thereafter, annually in the spring-summer, the stag regains lost weight rapidly with some increase in pre-rut peak weight expected up to about 5-7 years of age.

SELECTION FOR GROWTH

From a practical viewpoint, the earlier the replacement breeding stock can be selected, the better. The milk feeding period is a critical phase of the young deer's life, with milk intake at this time having a major effect on weaning weight, and therefore a major potential influence on the animal's production in later life. In the short term, however, the real advantage in recording weaning weight is to select the most productive hinds, ie, those that rear the best calves.

After the milk-feeding period, the period from 9-15 months of age can be regarded as the best opportunity to exploit the young deer's potential for growth. Potential growth rates are very high during this spring-summer period (as evidenced by indoor feeding trials with deer fed high quality diets to appetite) and under New Zealand pastoral conditions pasture growth is at its highest in spring. However a distinction must be made between

- the animal's potential to grow (growth potential),

and

- the actual growth rate,

since animals seldom achieve their potential for a variety of reasons. The growth potential is determined largely by the animal's genetic makeup which influences its capacity to eat, the efficiency with which it utilises its feed, etc. In contrast, the actual growth rate is a function of the interactions between the animal's genetic makeup and external factors, especially the quality and quantity of feed available, climate and disease. Therefore, in practical terms this means that comparisons between animals must be made on a within-herd basis with all animals given the same opportunity to express their genetic potential.

Consequently the weight at 15 months can be expected to provide a good indication of the animal's ability to express its genetic potential. However, as has been indicated previously, genetics alone do not tell the full story and a considerable proportion of the variability within a herd is not of genetic, but of environmental origin. Therefore when the objective is to select for improved growth rates or weight for age, the important weights to be recorded are

- weight at 3-4 months (usually weaning weight),
- weight at about 15 months,
- and for stags, the weight at 25-27 months.

Weaning weight

It can be expected that weaning weight of the calf will be a function of several factors in addition to the hind's milking or mothering ability. For example, the age of the calf at weaning and its sex are likely to be important variables. As well, factors which could influence the hind's milk production include her age and weight. Therefore in trying to rank hinds in terms of their mothering ability, we endeavour to take account of these various factors. Although only a very few sets of farm records have been analysed to date, the following effects have been recorded within herds:

- weaning weight of male calves is about 5 kg heavier than female calves (ie about 10-12%)
- weaning weight increases by about 0.25-0.5 kg/kg hind weight
- weaning weight increases by about 0.25-0.4 kg/day of age at weaning when calves are weaned pre-rut
- calves reared by 2 year old hinds are about 10% lighter than calves out of older hinds, even at the same hind weight
- the sire of the calf.

Practical approaches

The various factors which can influence weaning weight indicate the important things to record, namely:

- sire and dam of the calf
- birth date
- weight of dam
- weaning weight and date

Consequently, such a recording system requires that hinds be single sire mated, that the hind and her progeny be matched up, the birth date recorded and animals weighed.

Practically, the difficult areas are in the hind-calf pairing and the date of birth. However any recording-genetic improvement scheme is worse than useless unless the farmer can collect the information simply and accurately. Therefore several farmers have developed practical schemes (see Cowie 1985). With small mobs of quiet hinds, it is quite feasible to eartag calves soon after birth. Subsequently, the tagged calves can be matched with their dams. With larger farms and larger mobs, though, there is the sheer problem of numbers. While hind-calf pairing can be simply done at any stage prior to about 3 months of age, recording birthdate is much more difficult. This gets back to the question of the real importance of birth date in terms of its influence on weaning weight. Although our analysis shows that it has quite an effect, it is probably adequate to sort hinds into approximate groups, each covering a calving span of about a week. If this is simply not feasible it is essential that at least late calves (second cycle) be identified. In this case, it is accepted that the ranking of hinds will be compromised by the difference in birth dates, although of course there is argument that the best hinds calve early anyway.

Elite herds

The simplest way into a herd improvement programme is to select an elite group of hinds from within your own herd or from a group of herds with other farmers. This raises the question of how do you select the hinds for such an elite herd, without recording all your animals.

One approach is to weigh all the calves at about 3 months of age and sort out the heaviest, and then to match up these calves with their dams. To minimise the effect of the various possible complications, it is best to work within sire mobs (so that all calves considered are by the same sire) and to deal with first calving hinds separately. The hinds could then be sorted further on the basis of those which have reared the heaviest calves relative to their own bodyweight.

COMPLICATIONS

If a farmer wants to increase the average size and weight of his deer herd, the quickest way is to hybridise with wapiti or a larger (eg European) strain of red deer. However, numerous factors may argue against this strategy and the decision is to then select the most efficient animals from within the herd. Therefore this requires that somehow, there be an estimate of the animal's mature size in order to select that animal which is going to grow relatively faster. There is a considerable need for research in this area, but it seems that after allowing for differences between sires, that adjusting for the weight of the dam may be the most useful approach.

THE FUTURE

The whole area of recording schemes and schemes for genetic improvement in deer is one where there are likely to be considerable advances in the next few years. The information being collected through Deerplan (see Fennessy 1985) run by the NZ Deer Farmers' Association will be very useful in this respect.

FURTHER READING

Cowie, J. 1985. Practical deer recording and its benefits. *The Deer Farmer (26)*, 38-39.

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