DEER - A NEW BREEDING OPPORTUNITY

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BACKGROUND

The farming of deer officially began in New Zealand (NZ) in 1970, when the first licence was issued (Yerex 1982). Captured feral deer formed the basis of farmed stock and have since been augmented with imports of Red deer from the United Kingdom and Europe, and Elk from North America. Interest in deer farming was extremely high throughout the 1970's, partly due to the high interest shown in NZ as a source of velvet antler. While the industry continues to expand, sale prices of live deer in NZ have fallen dramatically over the past few years. This has largely been caused by changes in taxation laws and the generally depressed state of the NZ economy. Deer farms are now commonplace in all areas of New Zealand.

WHERE WE ARE TODAY

As at 30 June 1987, 500,397 deer were being farmed on 4316 farms throughout NZ (MAFCorp 1988). Of these approximately 79% were Red deer, 12% were Wapiti/Canadian Elk or their crosses with Red deer, 8% were Fallow deer and 1% were from other species (Sika, Rusa and Pere David).

Females made up approximately 67% of the farmed population of Cervus spp. (refer to Table 1 for the common names). The proportion of females in Fallow deer was higher, 73%, reflecting the greater emphasis on venison production. The national average weaning percentage was close to 84% for the 1986 fawning season (MAFCorp 1988).

Nationally, 61,329 males aged two years and over were cut for velvet in 1986, with an average production of 1.07 kg (MAFCorp 1988).

PROJECTIONS

The Game Industry Board (GIB) have predicted that by 1990 nearly one million (m) Cervus spp. deer will be farmed in NZ, with this number increasing to nearly 1.7m by 1995 (Spiers 1987). By 1995 it is expected that the national Cervus spp. herd will comprise 18%

venison stags, 4% breeding stags, 18% weaner females and 60% breeding females. Fallow deer numbers are expected to increase to 93,000 by 1995 (Spiers 1987), with similar proportions of stock in each class.

VALUE OF EXPORTS

For the year ended 30 June 1987, 2,890 tonnes (t) of venison were exported from NZ for a value of $(NZ)24.7m (GIB 1987). By 1995, based on the above population projections, the export volume of venison is expected to reach 20,585t with an export value of $(NZ)108m.

For the year ended 30 June 1987 approximately 100t of velvet was exported for a value of $(NZ)10.5m. By 1995 the production of velvet is expected to be 102t, with an export value of $(NZ)8.2m (Spiers 1987). These predictions assumed that velvet production will peak in 1991 and then steadily decline as the current market also diminishes. Predictions have been based on a return of $80 per kg however, in 1987 the average price was around $100/kg and for 1988 the average is expected to be approximately $120/kg. These figures emphasize that while venison provides the greatest proportion of returns, velvet is a profitable by-product.

Nationally, the other major product from deer is their skin, which is made into the finest quality leather. For the year ended 30 June 1987, 53,718 skins were exported with a value of $(NZ)1.4m. By 1995 300,000 skins are expected to be exported with a value of $(NZ)9m (Spiers 1987).

Venison exports made up only 1.2% of the total value of meat exported from New Zealand during the 1985/86 financial year. Expectations are for venison to steadily increase in its importance to the NZ economy as farmers diversify into the more profitable deer farming industry and consumers become increasingly aware of the high proportion of lean in venison compared to other types of red meat.

SPECIES CHARACTERISTICS

Red deer and Wapiti/Canadian Elk freely interbreed producing fertile offspring. Fertile hybrids can also be produced by crossing Red deer with Sika, Rusa and Pere David deer. However, major socialization problems have resulted in no Red x Pere David crossbred fawns being born through natural mating in New Zealand. Fallow deer, which belong to a different genus do not interbreed with the other species listed in Table 1.

Table 1 Common and Latin names of farmed deer in New Zealand with typical mature female liveweights (kg)

Common name	Latin name	Adult female weight (kg)
Fallow deer	Dama dama	45-55[c]
Sika (NZ)	Cervus nippon	75[a]
Rusa (Australian)	Cervus timorensis	70-85[b]
Red (NZ)	Cervus elaphus	100[a]
Red (European)	Cervus elaphus	100-150[a]
Pere David	Elaphurus davidianus	?
NZ Wapiti-type	C. elaphus nelsoni x C. elaphus	170[a]
Canadian Wapiti, Elk	C. elaphus nelsoni, manitobensis, roosevelti	240[a]

a Fennessy (1987)
b English (1984)
c Adam (1988)

All deer species are farmed primarily for venison production. A typical carcass dressing percentage for 18-month Red deer is around 56%, with farmers aiming for a 45 to 70 kg carcass before the animal's second winter. Fallow deer tend to have a slightly higher dressing percentage of around 58%, with farmers aiming for a 28 to 30 kg carcass before the animal's second winter.

Fallow deer produce little velvet. Asher (1988) estimates velvet production to be 0.1 - 0.5 kg/buck when cut about 35 days after casting, which is seldom worth more than $(NZ)30 - 40/kg because of its small size. Velvet production is not considered a viable alternative to venison production for Fallow deer in NZ.

Velvet is harvested annually from Cervus spp.. Table 2 shows the average velvet production that can be expected from the various breed types at a number of ages. Several deer farms in New Zealand have specialized into velvet production using mainly Wapiti/Canadian Elk type deer due to the greater weight of velvet and higher grade (a subjective measurement based on length, circumference, number of tines, stage of cutting, colour and mineralization). Relative antler yield of 5 year old stags (velvet weight/kg of summer liveweight) was shown to be 100, 109 and 117 for Red, NZ Wapiti-type x Red hybrid and NZ Wapiti-type deer, respectively (Moore and Brown 1987).

Table 2 Velvet antler yields (kg) by age (years) for Red, NZ Wapiti-type x Red hybrid and NZ Wapiti-type stags born in 1980 (from Moore and Brown 1987)

Age	Red	Hybrid	NZ Wapiti-type
2[a]	1.4	1.6	2.0
3	1.9	2.5	3.0
4	2.1	2.5	3.6
5	2.6	3.3	5.0
6	2.9	3.8	5.5

a antler cut as 65 days from casting

HYBRIDISATION

The extensive range of mature liveweights found across the Cervus genus illustrates the possibility of using hybridisation to improve the profitability of venison production through specialized sire and dam lines. Presently Wapiti-type males are being bred for use as terminal sires over Red deer hinds. Some farmers are establishing a breeding herd based on 3/4 Red and 1/4 Wapiti-type hinds. The proportion of Wapiti genes included in the specialized sire lines may depend initially on the ability of commercial farmers to handle the breeding males and to fine-tune pre-fawning management to ensure dystocia does not become a problem. As Wapiti are more prone to copper deficiencies (MacKintosh et al. 1986) and ryegrass staggers (Orr and MacKintosh 1985) than Red deer they will not be well suited to all environments.

Research being conducted at the Invermay Research Centre with hybrids between Red, NZ Wapiti-type and Elk deer will aid in the identification of problems and profitability of hybridisation programmes. The amount of heterosis expressed in these hybrids, for both weight and reproductive traits, also needs to be quantified. Table 3 shows the comparative liveweights of males from some of these crosses.

Table 3 Comparative liveweights (kg) for Cervus spp. males* (from Yerex and Spiers 1987)

	Weaning weight (14 weeks)	12-month weight	27-month weight
Red	46	75	133
NZ Wapiti-type x Red	56	100	165
NZ Wapiti-type	71	139	189
Elk x Red	63	135	?

* some data from one year only

Reproduction is another important feature of hybridisation. Farmer experience has shown that the reproductive rate of NZ Wapiti-type deer tends to be lower than that of Red deer. Moore and Brown (1987) gave the average weaning percentage of Red, NZ Wapiti-type x Red hybrids and NZ Wapiti-type hinds at the Invermay Research Centre from 1979 to 1983 as 86, 75 and 73, respectively. The lower weaning percentage in the NZ Wapiti-type and its hybrid was due to both lower fawning percentages and higher fawn mortality than Red deer. The average fawning percentage of Fallow deer is slightly lower than that of Red deer. Asher and Adam (1985) found that the weaning percentage of Fallow deer was 10% lower than that of Red deer from 1980/81 farm survey data.

From Tables 2 and 3 it can be deduced that there is little or no heterosis for either liveweight or velvet production in the NZ Wapiti-type x Red hybrid. This may be due to the genetic similarity of these strains. It is now known, through blood typing (Dratch 1987), that most NZ Wapiti-type deer carry some Red deer genes and that some of the larger Red deer carry some Wapiti genes due to interbreeding in the wild. Research work is currently underway to establish whether heterosis is present in Elk x Red hybrids. The summary of some reproductive traits recorded in the pure and hybrid NZ deer by Moore and Brown (1987) indicates that some heterosis may be present for these traits.

GENETIC PARAMETERS

Paternal half-sib analyses of farmed Red deer data collected through Deerplan, the national deer recording scheme in NZ, indicate that liveweight is highly heritable (Table 4).

Table 4 Paternal half-sib estimates of the heritability of birth weight, March weight (equivalent to weaning weight in beef cattle) and 15-month weight in Red deer with their respective standard errors (S.E.).

Trait	N	s	h^2	S.E.
Birth-weight	265	14	0.67	0.29
March weight	1131	59	0.77	0.15
15-month weight	342	28	0.60	0.22

N is the number of offspring
s is the number of sires

Genetic and phenotypic correlations between liveweights were consistently positive and were of similar magnitude to those found in beef cattle.

There are no published estimates of genetic parameters for velvet antler production in Red deer, or any other species in NZ. The heritability of velvet antler weight in Chinese Sika-type deer was estimated to be 0.35 (Zhou and Wu 1979). This research also indicated that there is a strong positive correlation between body weight and antler weight. However, upon translation, it appeared that their estimates were derived from small, possibly biased, data sets. The estimate of the heritability of velvet antler weight should therefore be treated with caution.

Considerable data collection and analysis is required to obtain more reliable estimates in the populations of concern. Suitable data is being collected in NZ by the research centres and through the use of on-farm recording via Deerplan (which is to be incorporated into Animalplan from 1 October 1988). Animalplan is a multi-species animal performance and pedigree recording scheme. Information on the operation of the scheme is given by Wickham and Parratt (1988).

BREEDING OBJECTIVES

As shown above there are many breeding alternatives in the Cervus spp. and farming systems are still being developed. Once the individual's breeding objective has been determined, optimum breeding plans, which may include both hybridisation and selection within strain, can be developed. Present indications are that traits in the main areas of interest, venison and velvet, are heritable and positively correlated. Further work is needed in the areas of reproduction and velvet antler quality traits. It is expected that reproductive traits will be of low heritability, as is found in beef cattle. The genetic relationships between velvet antler, hard antler and liveweight traits could have important consequences for those intensively involved in velvet production or trophy farming.

For most farmers the objective will be to produce the greatest carcass weight in the shortest time for the least cost. The farmer is currently paid per kg of carcass with price/kg varying with the total weight of the carcass and fat depth. At present in NZ the majority of deer farms are understocked and feed could not be considered to be the limiting factor. Feed costs are expected to assume greater importance in the future.

For those wishing to breed specialised dam lines greater emphasis will be placed on reproductive traits and survivability. Possibly with consideration given to genetically restricting mature hind liveweight in order to reduce costs per weaner as feed becomes a limiting factor. Red deer sire breeders may select for all three traits, reproduction, carcass weight and velvet production.

Terminal sire breeders will probably place greater emphasis on carcass weights and possibly leanness, with some emphasis on velvet production.

Other traits that may be included in the breeding objective are temperament (many farmers place importance on handling ability) and disease resistance (particularly facial eczema tolerance in Fallow deer and perhaps internal parasite resistance).

GENETIC GAIN

A genetic gain of 1.19 kg/year in 15-month liveweight of Red deer can be expected based on the assumptions given in column A, Table 5. The generation interval of 6.5 years, used in this calculation, is likely to be what the industry is currently achieving (hinds culled at 15.25 years of age, and sires being used for the first time at 2 years of age with a number of 8 to 10 year old stags still in service).

If the generation interval were shortened to 3.75 years by culling hinds at 10.25 years of age and using only yearling and 2 year old stags, then genetic gain in 15-month liveweight would increase to 1.80 kg/year (column B, Table 5). Before this can be achieved present resistance to the use of yearling stags would need to be overcome. This resistance stems from the belief that traits measured on the yearling are not good indicators of genetic potential (particularly velvet production) and that yearling stags are not sexually mature and cannot be used in a single-sire mating group.

Table 5 Assumptions used for the derivation of genetic gain and genetic gain estimates (kg/year) from selection on 15-month liveweight and 2 year old velvet weight in Red deer.

	15-month weight A	15-month weight B	Velvet weight C
Weaning %	84	84	84
Sex ratio	50:50	50:50	50:50
Heritability	0.60	0.60	0.35
Standard deviation (kg)	7.0[a]	7.0[a]	0.35[b]
Stags selected (%)	3	5	5
Hinds selected (%)	20	30	100
Selection differential (kg)	12.85	11.27	0.36
Average age of stags (yrs)	5	2.5	3
Average age of hinds (yrs)	8	5	8
Generation interval (yrs)	6.5	3.75	5.5
Genetic gain (kg/year)	1.19	1.80	0.023

[a] 15-month liveweight adjusted phenotypic standard deviation (Rapley unpublished)

[b] 2 year old velvet weight adjusted phenotypic standard deviation (Fennessy pers. comm.)

If the assumptions in column C, Table 5, are indicative of the true situation for velvet production then a genetic gain of 0.023 kg/year can be achieved in 2 year old Red deer stags. At a current average gross return of $(NZ)120/kg this equates to $1.38 per 2 year old progeny cut for velvet. As 2 year old production is considered to be a good indicator of later production, the return per progeny lifetime is likely to be greater. The correlation between liveweight and velvet weight reported by Zhou and Wu (1979) indicates that an accompanying increase in bodyweight (and carcass weight) would also occur.

Costs of performance recording are likely to be low in relation to the value of potential gains. Some difficulty will be encountered in obtaining measures of subjective traits such as velvet grade due to the number of factors considered and the variable nature of the grading system.

THE FUTURE OF DEER BREEDING

The development of selection indices for the deer industry is currently underway. Particular emphasis is being given to the calculation of relative economic values and the identification of selection criteria to predict traits included in the objective. For example, the use of spiker antler weight to predict 2 year old and later velvet production.

Rapid progress in both the estimation of parameters, development of selection indices and the application of these is expected over the next few years in the NZ deer industry.

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