DEER FEEDING: FERTILE GROUND FOR QUALITY IMPROVEMENT

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1. INTRODUCTION

There is nothing new in the maxim that feeding is the key component of grazing livestock systems Equally, there is nothing new in the observation that optimum feeding is not often achieved on farms Deer farms are no exception There has been a significant amount of literature published on deer feeding and management, along with financial analyses (see reference list) and many, although not all, of the principles of feeding, nutrition and management developed for other grazing species apply to deer

This paper summarises the range of production levels related to feeding on deer farms and how feeding affects those outcomes Full detail of individual farm and animal performance levels is published elsewhere (Audigé 1995) This presentation will also consider some of the reasons for variation in performance, some simple financial models, and will demonstrate that there is indeed substantial opportunity within the deer industry for quality improvement in feed-related outcomes and that their achievement will be financially rewarded

2. PRODUCTION OUTCOMES INFLUENCED BY FEEDING

The biological outcomes on deer farms can be measured as growth or bodyweights, reproductive performance, velvet antler production and health This section will present summaries of survey data of the range of outcomes of each of these categories from the study by Audigé *et al* (1995), to demonstrate the variability that exists between farms This data can be used to define quality, to set targets, and for diagnostic purposes as discussed by Wilson *et al* (1995)

***NOTE: Numerous factors contribute to variation in data presented here**: feeding is only one of those factors Management, genetic, environmental and other biological factors contribute either directly or indirectly to each outcome. Detailed models of these effects and interactions are to be found in "Deer Herd Health and Production Profiling"* (Audigé 1995)

2.1 Growth

This section will focus on a few simple comparisons A selected sample of mean minimum and maximum average farm data, for weights of weaner, yearling and adult deer, are presented in Table 1

Table 1. Sample of herd mean body weights ((kg) from 16 farms over 2 years

		Mean herd	Minimum herd	Maximum herd	
Weaner (April 1)	M	49 8	43 0	55 5	(+ 29%)
	F	46 4	30 3	54 4	(+ 42%)
12 month (Dec)	M	81 2	66 7	102 9	(+ 54%)
	F	71 4	59 4	88 9	(+ 49%)
15 month (Mar)	M	94 6	83 2	120 4	(+ 45%)
	F	79 9	67 1	98 1	(+ 46%)
Adult	M	137 3	122 7	162 8	(+ 33%)
	F	98 4	89 2	105 8	(+19%)

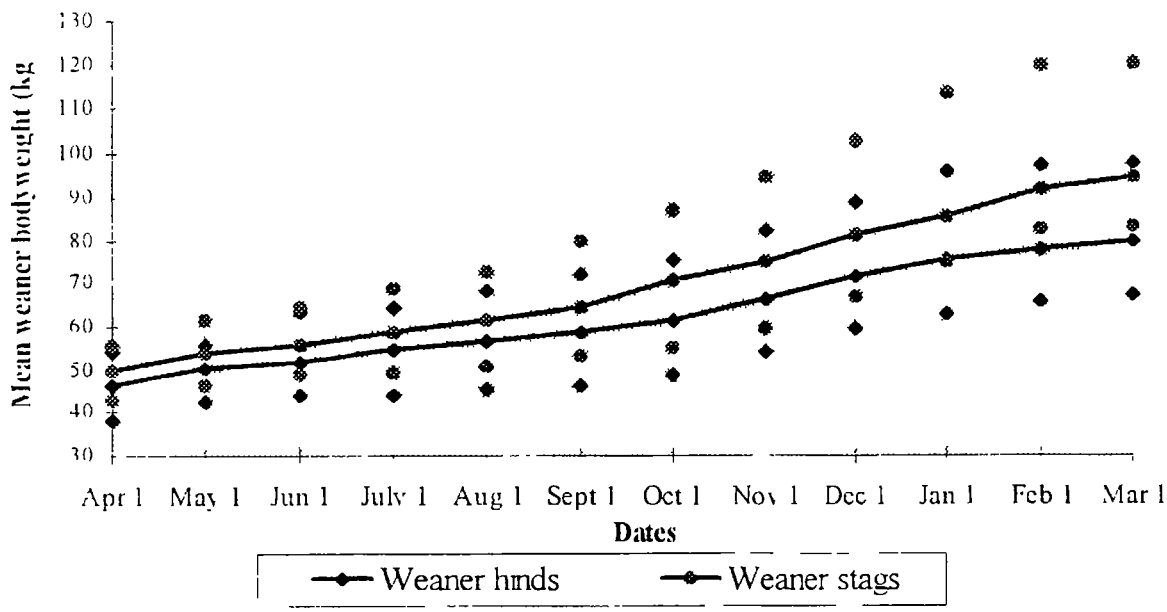

Figure 1 Median (line) and range (dots) of farm mean bodyweights of weaner hinds and stags Data from 1992 and 1993 combined

Figure 1 shows median herd growth rates for male and female weaners

Note these are herd averages and within those herds a range of bodyweights exist These data show substantial variation between farms

Economic analyses of the impact of these differences can be undertaken for a range of scenarios Three crude examples will be discussed

2.1.1 Weaner weights and values

The 17 kg difference in male weaner weights between farms would yield an average $85 per male and $48 per female if sold April 1 (this is based on current market rates $5/kg liveweight for males, $4/kg liveweight for females

2.1.2 Yearling weights and Venison sales

A crude analysis of the effect of weight on gross carcass value of stags is presented in Table 2 Note these returns are based on per animal values and are not gross margins No account has been taken of differences in stocking rates to achieve different growth rates These data demonstrate clearly the concept of payment for quality (see Section 5) Thus a 44% difference in liveweight translates to a 93% difference in carcass value, because optimum carcass weights achieve a premium price A similar but smaller response is observed at a later age This is a result of the increased bodyweight of the liveweight group into a higher schedule bracket

Note these figures are based on the average within a herd Every herd will have a range of bodyweights and therefore carcass values

Table 2. Crude analysis of the effect of weight on gross carcass value of stags

	Herd Average (wt. kg)		Gross carcass	
	Live wt	*Carcass wt ($/kg)*	*Value ($)*	
12 months				
• heaviest herd	102 9 (+ 44%)	56 6 ($7 50)	424	(+ 93%)
• lightest herd	66 7	36 7 ($6 00)	220	
15 months				
• heaviest herd	120 4 (+ 44%)	66 2 ($6 60)	437	(+ 54%)
• lightest herd	83 2	45 7 (6 20)	283	

The range of achievement of optimum carcass weight at 12 months of age can be further visualised by examining the number of stags achieving given bodyweight measures at 12 months of age (Wilson *et al*, 1995) This data clearly demonstrates that some farms achieve almost 50% of animals reaching optimum slaughter weight whereas others achieve none The economic impact of these differences is obvious

2.1.3 Effect of hind weight on weaner weight

A 16 kg difference in mean hind bodyweight (see Table 1) will result in a difference in conception date of up to four days according to overseas literature, with this trend confirmed by Audigé *et al* (1994) This effect alone should produce weaner calves that average 1 32 kg and 1 2 kg heavier for males and females respectively At today's price that results in a live sale value increase of $6 60 and $4 80 per head respectively Note this effect is repeated annually, demonstrating the long term effect of nutrition early in life

2.2 Reproduction

Table 3 summaries mean and range of hind pregnancy rates at scanning, and Figure 2 gives individual farm early, overall and non-pregnancy rates for yearling and adult hinds We define a "quality" outcome as being early conception Thus for adult hinds, while there is not a great range in conception rate *per se*, there is a considerable variation in conception dates between farms For yearling hinds there is wide variation in both conception rate *per se* and conception date patterns

Figure 2. Percentages of yearling and adult hinds conceiving before May 1, conceiving after May 1 and not pregnant on each survey farm in 1992 and 1993

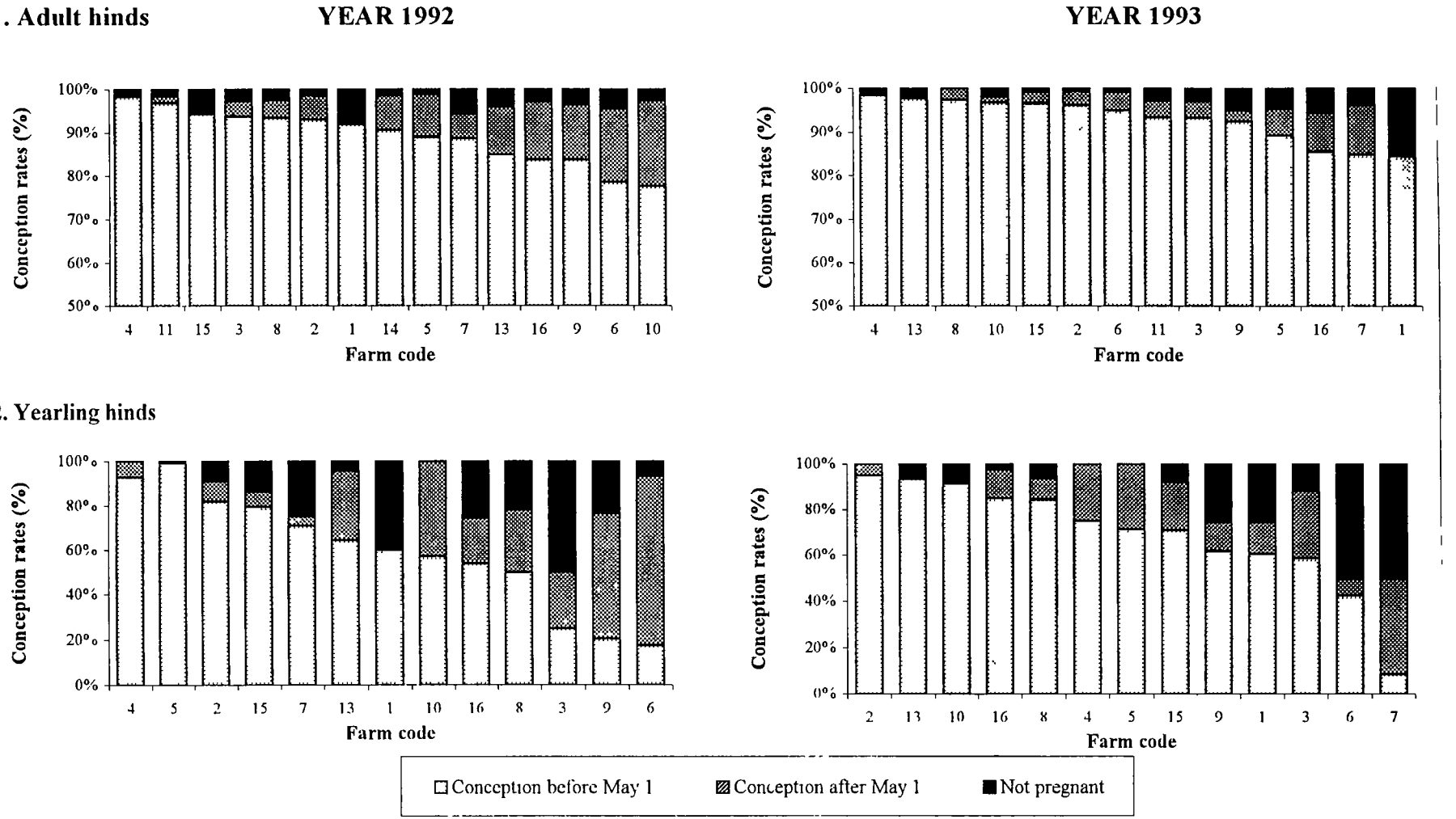

Table 3 Mean and range of hind pregnancy rates (%) between farms

		Mean	Minimum	Maximum
Yearling	Year 1	83 6	50	100
	Year 2	84 7	50	100
Adult	Year 1	96 9	92 7	98 8
	Year 2	96 8	84 6	100

The influence of bodyweight in attainment of puberty is well known Red deer are unlikely to conceive if they don't achieve 65 kg liveweight Data from Table 1 shows the lowest bodyweight herd achieving 67 1 kg mean liveweight pre-mating, thus the potential for conception rate in that herd is inextricably low Furthermore, the effect of bodyweight on timing of conception will mean that those which do conceive will conceive late Data published elsewhere suggests that for every 4 kg heavier, a hind will calve on average one day earlier, all other factors being equal Thus, even between the mixed age groups one would expect a difference in median calving date of approximately 4 days, attributable to bodyweight differences alone One effect of this has been discussed in 2 1 3 above

In addition to bodyweight, body condition score (BCS) *per se* is a critical factor influencing reproductive success BCS will be discussed in Section 3 2

Feed-related factors also influence the ability of the hind to rear a calf to weaning, the dystocia rate and the weight of offspring produced by that hind to weaning (see Table 6)

2.3 Velvet antler weight and grade

Farm mean velvet antler weights are shown in Table 4

Table 4 Farm average velvet weights (n = approx. 1400 stag years)

		Mean	Minimum	Maximum
2-year-old	Year 1	1 16	0 89	1 54
	Year 2	1 19	1 04	1 52
Mixed age	Year 1	1 94	1 38	2 72
	Year 2	2 15	1 93	2 76

As for other parameters, a wide range of average velvet weights exist between farms Averages vary 46-73% for 2-year-olds and 43-97% for mixed age stags At these averages the average stag on the heaviest velvet producing farm would yield approximately $380 ($1 40/kg A Grade), and the average stag in the lightest producing herd will yield approximately $165 (@ $1 20/kg) While the best velvet weight-producing herd in our survey was the herd with the highest mean body weight, the additional cost of providing for slightly higher maintenance feed levels is vastly offset by the better quality and quantity of production, and therefore financial return

2.4 Health

A wide range of health problems can be influenced by feeding Two examples will be given

2 4 1 - Yersiniosis

It is widely held that yersiniosis outbreaks are precipitated by "contributory stress" Underfeeding is widely quoted as a principal stressor However, the influence of feed-related factors on precipitation of a yersiniosis outbreak may be very complex and be either direct or indirect Some examples follow

* **Direct underfeeding** resulting in a reduction in rumen fill, a decreased flow rate through the intestine allowing a build-up of organisms, particularly if the environmental bacterial contamination rate is high,

* **Direct underfeeding** resulting in a reduction in rumen volume and metabolism, limiting heat production While in normal circumstances this may not threaten the animal, in times of inclement weather, poor shelter and high exposure factors the animal's metabolic rate may decrease, allowing the physiological environment to favour the causative organism Thus, in terms of diagnosis of the impact of the level of feeding, the interaction with climatic factors must be taken into account

* **Reduced feed quality** results in an increase in rumen retention rate, ie slow digestion, and a reduction in the rate of passage of material through the intestinal tract, hence favouring the organism, and reducing heat production

* **Change of diet:** Rapid dietary changes may result in a reduction in appetite, particularly if the feedstuff is not palatable, effectively resulting in under-feeding

* **Change of diet:** A sudden change of diet may result in a change in digestive metabolism altering the intestinal tract environment, possibly favouring the causative organism with the above results

Thus, feed quantity, feed quality and management practices may be involved, either individually or collectively

2.4.2 - Copper metabolism

The interaction between feeding and copper is also very complex

* **Pasture composition:** Different pasture species contain different copper levels, eg legumes generally are higher than grass,

* **Pasture mineral composition:** Other competing elements such as molydenum and sulphur restrict the availability of copper for absorption Soil pH will influence some of these elements, eg molybdenum content of pasture,

* **Pasture quality:** Copper availability is higher in more mature pastures, and higher in hay than in fresh grass

* **Feed level** A pasture with a marginally adequate copper level will provide for the metabolic requirement of the deer If that pasture is fed at below maintenance, liver copper reserves may be utilized rapidly as a result of insufficient intake

* **Pasture management:** Soiling of pasture will increase iron intake which reduces absorption of copper

Thus, feed quality, feed quantity and management practices influence copper metabolism in the animal

Malignant catarrhal fever, gastrointestinal and lung parasitism, facial eczema, ryegrass staggers and tick and lice infestations are all influenced by feed management Similarly, feed level influences the immunological competence of animals and therefore the susceptibility of deer to a range of infectious agents is influenced by feeding decisions

3. THE EFFECTS OF FEEDING ON PRODUCTION OUTCOMES

It is an oversimplification to suggest that feeding has only one influence, for example, on bodyweight, or that the effect of feeding is manifest in only one way, eg conception rate Feeding influences all the production outcomes described above, but the effects of feeding and feeding decisions can be positive or negative suggesting optimum ranges of feeding levels and management practices exist for some outcomes For example, below a threshold body condition score, reproduction will be impaired above a critical body condition score the risk of dystocia increases (see Wilson and Audigé, this Proceedings, for further discussion)

This section utilises the multivariable models developed by Audigé (1995) to describe the major associations between feeding and feed management practices and each outcome investigated The relationship between feeding and management practices and outcomes may be direct or indirect Again, the reader is referred to Audigé (1995) for a full description of these effects

3.1 Growth

There is no dispute that feeding directly affects growth A considerable amount of research into deer growth was carried out in the early 1980s (Suttie, 1987) More recent work has investigated means of achieving optimum growth by varying management practices and pasture species (Ataja *et al*, 1991, Semiadi *et al*, 1993, Niezen *et al*, 1993, Kusmartono *et al*, 1995, Sortrisno *et al*, 1994), and also by artificial means such as minimising seasonal signals by endocrine means such as melatonin (Dominque *et al*, 1990), immunisation against hormones (Freudenberger *et al*, 1991 and 1993), and lighting regimes (Suttie, 1994)

Table 5 describes the effect of various feeding inputs on growth to 15 months of age The effects are either direct, eg the weaner converting feed into weight gain, or indirect, eg the influence of hind bodyweight during pregnancy and body condition score during lactation, in providing a greater opportunity for the offspring to grow The latter is an acutely important observation and highlights the need for an holistic approach to management to achieve the optimum outcome Thus, the best weaning weight will not be achieved by feeding the weaner alone It will only be achieved if attention is given to the nutritional status of the dam pre-mating, during mating, during gestation and during lactation

Table 5. Effect of feed-related factors on weaner growth

Outcome	Sward height	Strip grazing	Clover	Dam weight	Dam BCS
Weaning weight	+		+	+ (winter)	+ (during lactation)
Growth					
* *autumn*	+	+	+		
* *winter*	+				
* *spring*	+				
* *summer*	+		+		

It is clear from research (Ataja *et al*) that a minimum sward height of 10 cm is needed to achieve maximum weight gain on pasture This pattern is similar for sheep and cattle growth, and also milk production Thus, grazing management decisions relating to pasture residual heights at which deer need to be moved are critical In the author's view, establishing and controlling minimum grazing pasture heights is the simplest and most effective means of ensuring optimum or target production levels Most farmers do not achieve optimum deer growth rates because of a failure to understand this principle

In addition to management decisions, selection of pasture species can further increase growth rate Enhanced growth has been recorded at Massey University Deer Research Unit on red clover, chicory, sulla and lotus under various grazing conditions For some pasture species the effects are compounded by genotype, for example, it has been observed that red-X Wapiti 25% hybrids grew disproportionately faster than red deer grazing chicory Thus, different deer species appeared to either have different intakes or feed metabolic processes resulting in different outcomes

Our studies of commercial farms showed that strip grazing in autumn and the amount of clover was associated with growth rate at certain times of the year Our research has indicated that using specialist feeding systems can result in achievement of 100% of stags reaching 92 kg by December 1 Compared with data shown in Figure 1, even the best commercial farms could achieve significant improvement in production outcome by adopting new but already available technology

3.2 Reproduction

The general effects of feeding on reproduction are summarised in Table 6

Table 6 Effect of feed-related factors on reproduction

Outcome	Sward height	Hind body condition score	Hind weight	Weight gain
Early conception				
• adult	+	+		
• yearling	+	+	+	
Conception	+			
• adult	+	+		+ (rut)
• yearling		+ (- at high BCS)	+	
Rearing calf				
• adult	+	+	+	
• yearling				
Dystocia		+*		++ (Spring)
Weaning weight	+	+	+	

Note The timing and magnitude of relationships are published elsewhere (Audigé, 1995)

* BCS over 4 increases risk of dystocia

+ ie higher weight gain increases risk of dystocia

Sward height influences conception rate, conception date and ability to rear a calf The effects are via bodyweight and/or body condition score (BCS) There is generally a relationship between weight and BCS, thus for most outcomes both of these factors are contributory However, for some outcomes - for example, conception and early conception in adults - body condition score is more important than weight *per se* The reason for this, we believe, is that within our study farms the threshold weight for achievement of conception had already been achieved (> 65 kg)

Our studies also confirmed the observation of others (Lawrence, 1985, Smythe, 1985) , that the risk of dystocia increases in hinds with a high body condition score

A further observation is that the relative effect of feed-related outcomes may differ between age groups Our model suggests that little of the variation in ability of a first-calving hind to rear a calf was attributed to feed-related factors, suggesting that other factors not measured, (eg behavioural or physiological) may be relatively more important in that age group

Our survey data has suggested that body condition score is a critical factor influencing reproductive outcomes The reader is referred to Audigé, (1995) for specific detail Body condition score is directly influenced by feeding, but other factors such as concurrent disease may contribute in some herds It is significant to note that BCS of hinds is not only associated with conception *per se*, but also weaning weight, date of calving and weaning percentage, the latter via both dystocia and calf survival measures

The positive and negative relationship between BCS and conception in yearling hinds indicates that body condition scores at both extremes are likely to reduce conception irrespective of bodyweight once the threshold has been achieved While this observation needs further substantiation, it suggests that farm managers should ensure that yearling hinds do not become excessively fat at the time of mating This association was not observed in adult hinds in relation to conception

3.3 Velvet antler production

Table 7 shows the principal associations between feed-related factors and velvet production outcomes

Table 7 Effect of feed-related factors on velvet production

Outcome	Sward height		Supp feed		Clover	Strip feed	Weight gain		June wt
	Winter	*Spring*	*Winter*	*Spring*			*Winter*	*Spring*	
2 y o									
• weight	+	+				+	+		+
• grade		+	-		+	+	+		+
Adult									
• weight	+		-			+		+	+
• grade	+		-					+	+

More feed-related variables appear to be associated with velvet production than most other production outcomes recorded This lends strong support to the hypothesis that improved feeding could be a major factor contributing to higher velvet production on commercial farms

Some effects were consistent between 2-year-old and adult stags, although the magnitude of the effect may differ The observation that sward height in winter was associated with weight, not grade, is an interesting observation, yet in spring the association with pasture height was positive for both outcomes This requires further evaluation The effect of June weight shown here is consistent with other observations, indicating a relationship between stag weight and velvet antler production (Moore, 1988)

The observation that supplementary feeding was negatively associated with velvet weight and/or grade indicates not that supplementary feeding reduces velvet weight but that management decisions were inappropriate This was probably because supplementary feeding commenced either after the effect of the feed shortage had been felt by the stag and/or that the quantity/quality of supplementary feed was insufficient Either way, this suggests that many farmers underestimate the feed requirement of stags during winter, or underestimate the effect of feeding on velvet antler production

3.4 Animal health

It is extraordinarily difficult to gather good data on commercial deer farms which allows investigation of the association between feeding and management factors, and incidence of disease This is compounded by the sporadic nature of disease occurrence, the low incidence of disease, and difficulties in obtaining accurate diagnoses Our observations of the association between feed-related factors and the risk of yersiniosis are presented in Table 8 High weaning weight, high winter bodyweight and high growth rates are associated with a low incidence of yersiniosis Our

survey indicated that weaner mortality rates varied between properties from zero to 30%, the latter figure was a yersiniosis outbreak in the herd with the lowest growth rate

Table 8 **Effect of feed-related factors on the risk of yersiniosis**

Parameter	Effect
High weaning weight	↓
High June weight	↓
High growth rate weaning - June	↓
Wide range of bodyweights within mob	↑

↓ = reduced risk, ↑ = increased risk

An interesting observation was the association between the bodyweights within a herd and the risk of yersiniosis Thus, lightweight animals in a herd with a wide bodyweight range are more at risk of yersiniosis than the lightweight deer in a herd with a small range of bodyweights Therefore management which stratifies deer into mobs according to bodyweight may reduce the risk of yersiniosis independent of the body weight *per se* While this may not be practical in smaller herds, it would be a feasible practice in larger herds

4. WHY ARE FEEDING OUTCOMES NOT ALWAYS OPTIMAL

There is a multitude of reasons why feed-related outcomes are not always optimal on deer farms Some of these factors are

* Climatic - seasonal and geographic variability exists However, while climate *per se* may not be controlled, the effects of climatic variation can be managed
* Geographic areas within New Zealand have different sward pasture production characteristics, many of which are linked to climate
* Farming objectives and philosophies - this is an acutely important consideration given that some farmers do not have high productivity, high profitability or quality outcomes as their imperatives, for example, lifestyle or low labour input may be more important
* Farmer ability/knowledge - to achieve the optimum outcome the farmer should be knowledgeable in all input and output factors, and every factor which contributes to each of those Thus, it is our belief that while many farmers operate on an intuitive basis, the best and most repeatable quality outcome can be achieved only by those farmers that are fully educated and informed about what they are doing
* Stocking policies - many farmers underestimate the feed requirements of deer, particularly those for growing weaners and velvet production Some areas of the country are more suited to breeding hinds than finishing weaners

* Pasture types - ryegrass and browntop, the predominant grass species in pasture, are amongst the least preferred feedstuffs for deer This reduces feed intake and therefore growth and production potential Knowledge of feed preferences and willingness to adopt new technology would result in significant improvements
* Animal health - our survey indicated that on many farms disease prevention programmes are responsive or intuitive rather than planned Thus, the risk of clinical and subclinical disease is higher than necessary
* Economic/financial considerations - constraints of cash flow/debt structure may limit the farmer's ability to achieve outcomes despite knowledge on how to achieve them, eg re-grassing or purchase of supplementary feeds require financial inputs, but are impossible if finance is not available
* Farmers are generally not good in seeking advice from experts, preferring either to observe other farms which may be suffering from the same phenomena, or by self-experimentation In our view current knowledge is sufficient to achieve major gains in quality outcomes on deer farms, and that a significant extension programme needs to be implemented in order to capitalise on current knowledge
* Market fluctuations - these occur within and between seasons They are sometimes related to procurement policies by purchasing companies or speculation Some farmers' decisions will be influenced by such fluctuations

Some of the above factors we an control, some we can influence, and some we can only manage as they occur Theoretically, to achieve the optimum outcome in any circumstance the decision-maker must be fully conversant with all factors that can influence the outcome, ie he/she must be educated To achieve optimum feeding the decision-maker must know their targets, feed requirements and how to meet them, the long- and short-term implications of compromises, the full range of options available and how to evaluate the options financially The ultimate goal of the veterinarian or adviser should be to equip the farmer with that knowledge and skill, to be independent, with the ability to make the right decisions all the time with the emphasis on planning to achieve targets and prevent problems

It therefore becomes imperative that the veterinarian or adviser must possess knowledge of both a generic nature, relative to the farm or the district, eg climatic patterns, pasture production patterns, species effects, soil fertility, agronomic considerations, and of a farm-specific nature such as farming policy, financial situation, farmer knowledge and ability, genetic and environmental constraints It must be remembered that advice on feeding is only as good as the ability of their farmers to implement the advice (Wilson, 1995) For example, if the financial situation is critical any advice which requires expenditure from non-existent cash flow will be useless In that instance, cash flow imperatives may dictate that the appropriate advice would involve decisions on other aspects not immediately or directly related to the problem at hand in a biological sense, eg quitting stock, grazing out, generating revenue from other sources, perhaps even by selling other classes of stock Those situations require lateral thinking by the adviser and farmer

5. FEEDING OUTCOMES, QUALITY AND QUALITY SIGNALS

The deer industry is striving for quality Quality may be broadly defined as "what the customer wants when the customer wants it" The most tangible signal to the farmer is the dollar value for the product

The venison market has clear quality signals Firstly, the seasonal fluctuation in schedule indicates that the product preferred in spring (New Zealand time) The GIB is encouraging markets to spread venison consumption throughout the year, but the present pattern is likely to persist given the reliance on traditional European markets However, the magnitude of seasonal price fluctuations may reduce

Secondly, the unit value ($/kg carcass weight) at 50-65 kg is higher than the values per kg of carcass weights above and below those critical figures For example, a 50 kg carcass may be worth $375 ($7 50/kg) yet a 49 5 kg carcass may be worth $351 ($7 10/kg) Thus the value of the last 0 5 kg of carcass growth is $24 In the recent past the differential has been up to $52 50 The message is clear A 50-65 kg carcass in spring is what the market wants Fraser (1993) produced an excellent summary of the cost benefit of systems orientated to producing quality (optimum carcass weight) compared with quantity (higher stocking rates, low carcass weights) production Gross margins favoured quality by up to $244/hectare

The velvet market has a similar signal the higher the grade, the higher the price per kg Weight is broadly related to grade and therefore $ return per stag, although at the marginal extremes of grades, weight differences may mean that on some occasions the effective weight will compensate for lower grades and *vice versa* Only a small percent of velvet would fall into this category, thus the message again is clear - heavy velvet Feeding affects velvet production but a considerable amount of research needs to be conducted to ascertain the full effects of life-long and year-round feeding practices, to enable farmers to more ojectively manage the feeding of stags

We believe it is critical that the year-round influence of feeding and management practices be considered and our multivariable models support that concept Thus, some of the research published on velvet antler production needs to be viewed with caution For example, a recent report indicated that feeding chicory in spring to adult stags did not increase velvet weight The popularly drawn conclusion was that chicory provided no advantage for velvet production However, that conclusion may not be correct since the effect of winter feeding may have compounded the result Further, chicory fed in summer and autumn may have a direct and/or indirect effect on velvet production through weight gain, body condition score or other metabolic influences Research at Massey University (Kusmartono, 1996, Min, 1996) has shown that chicory fed to weaner and yearling deer increases spike velvet weight independent of the effect of bodyweight alone Thus, the concept that different pasture species may have unique characteristics which influence velvet production should not be discounted Further research is urgently needed

6. QUALITY IMPROVEMENT

The deer industry on-farm quality assurance program (Game Industry Board Farm Quality Assurance Standards, published GIB) currently focuses on facilities, welfare and health These specifications are general but provide a vital starting point As the quality assurance programme

develops it is the author's opinion that the definition(s) of "quality" will evolve to be more specific For example, at present a farm may have an adult hind weaning percentage of 68 (cf 87% average), a mixed age hind weight of 90 kg (cf 98 kg average), a yearling hind weight of 72 kg (cf 81 kg average), no yearling stags that achieve 92 kg by December 1 (average approx 16%), a weaner mortality rate of 10% (average 5 87%) and a mixed age stag velvet production of 1 7 kg (average 2 15 kg) yet be accredited One may question whether the outcomes observed on that property are representative of quality

We therefore predict that under the concept of quality improvement, the logical extension of quality assurance, will require that accredited farmers demonstrate achievement of defined minimum production standards or outcomes The mechanisms for introduction of such a system are complex given the range of events that contribute to performance, not the least of which is climatic outside the farmer's control However, the concept will require a better educated and more skilled farmer and farm manager than exists on average today Management decisions will need to be more technical

Table 9 demonstrates the potential financial effect to the New Zealand deer farmer and the industry as a whole if certain improvements in productivity related to feeding are made The figures proposed for improvement in this Table fall well within potential, and could be established as short-term industry targets

Table 9 A simplified analysis of the annual economic benefits to the New Zealand deer industry of modest quality improvement achievable by better feeding

Component	Deer	Target	Outcome	Total $ value to farmer (millions)	$ value per average farm
Reproduction	yearling hind	+ 10% weaning rate	20 000 more carcasses @ 50 kg	7 5	1500
	adult hind	2% ˙ weaning rate	8 000 more carcasses @ 50 kg	3 0	600
Growth	all classes	˙ liveweight 2 kg	heavier carcasses (800 tonnes)	6 0	1200
Mortality	all classes	↓ mortality 1% point	16 000 more carcasses @ 50 kg	6 0	1200
			Combined effect	**$22 5**	**4500**

Note: A cost-benefit analysis at the farm level must recognise that the application of knowledge and skill is perennial, yet the attainment of that knowledge was finite Thus the payback on the capital investment in advice by the individual farmer is enormous

The deer industry currently contributes significantly to New Zealand's economy and therefore society The impact of improving productivity is felt way beyond the farm, through all of the support components of the deer industry and therefore into the community at large

7. CONCLUSION

The future role of the veterinarian and other agricultural consultants is obvious At current price differentials for quality, at current production levels, at current knowledge of how to improve production and quality outcomes, the area of feeding does indeed provide fertile ground for quality improvement The challenge is to convince the producer that in addition to being the entry price to the market, quality pays The discussion and figures produced in this paper demonstrate that there is significant room for improvement of quality and economic return

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