DEEResearch Ltd

~ A Review~

Deer Industry Productivity Growth Targets and Measurement

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AgResearch

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Contents

Review of Deer Industry Productivity
Growth Targets and Measurement

1. Executive Summary

The deer sector as a new and fast growing industry has been more focused on managing growth than it has been on measuring its productivity. The ratio of product volumes or value to necessary inputs such as farm costs, capital and land are briefly considered in the dairy and wool sectors as they are relevant to the deer industry. Biological components of productivity are superficially reviewed with the comment that reproduction, nutrition, breeding and management deserve a full review in order to help establish research priorities.

Some tabulated information is presented showing the massive range between farms in some important areas of productivity e.g.

- calves reared/100 rising 2 year hinds can range from 11 to 92.
- growth rate in calves during the second half of lactation can range from 200 – 700 g/day.

Industry productivity is a function of a myriad of processes in the supply chain from the farm to the consumer and the review suggests that a modelling approach at two levels will help focus on priorities:

1. on-farm productivity – reproduction; growth; wastage
2. off-farm productivity – slaughter/dressing; cutting/packaging; transport; storage; marketing

The precise supply for the chilled year-round venison FRST contract is reviewed, as are 3 major deer farmer projects. The Southland Deer South benchmarking project, currently being extended to 5 other regions is a suggested vehicle for a national structure of performance review and productivity gain assessment.

The deer industry needs to establish productivity/performance targets before it can clearly identify the relevant gaps in knowledge but it is clear that better market feedback to science is necessary if progress is to be made.

Research priorities are established around those directed at DEERresearch Ltd and those at the wider industry.

Key priorities are:

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- commission a detailed review of reproduction, nutrition, breeding and management.
- develop a breeding hind model so that industry growth can be more precisely assessed.
- extend research into deerskins for fashion garments.
- using a modelling approach, establish gaps in our knowledge about growth, lactation and production.
- implement a system to establish Estimated Breeding Values in the wider deer industry as a means of making progressive genetic progress.
- establish pasture management workshops around the country as a component of growing productivity.

Topics for the wider deer industry:

- establish a measure of national velvet antler production.
- establish the possible value of PRIM software (from Meat NZ) to chilled venison supply chain analysis.
- determine deer industry performance growth targets.
- Foster the national benchmarking project (the extension of Deer South) as a major method of technology transfer and productivity gain.
- encourage “economic farm surplus” recording in the above benchmarking project to document changes in productivity over time.

2. Introduction and scope of the review

The deer farming industry in New Zealand started in the early 1970’s and in thirty years has grown to about 1.5 million breeding hinds. This high rate of growth has masked the productivity change that way be occurring taking due account of animal performance, farm costs and the farm land which is occupied by deer. The present review was always likely to show that there is a lack of necessary data from which useful productivity calculations about deer farming could be made. It is, however, a very worthwhile exercise to examine the elements of productivity and make suggestions about future progress in the field.

The biological fields of reproduction, nutrition breeding and management are all very important parts of animal and farm productivity but should be reviewed in their own right in a separate exercise. The present review does nothing more than list relevant areas of biology and comment on the scope of variation among deer farmers.

Lessons may be learned from the dairy/wool/meat sectors, who are all struggling with finding ways of assessing productivity and estimating rate of change. The probable new deer industry structure (Deer Industry NZ) should facilitate communication with the traditional livestock industries in a better way than in the past. Fundamental market information and projections for the future are matters on which this review comments because it is central to long term industry profitability.

3. Productivity – the state of knowledge

3.1 Concepts and definition

Productivity as the ratio of output/input can be measured many ways depending on how outputs and inputs are quantified. Some people maintain that in order to compare production options in terms of productivity a "steady state" system is necessary. This concept is difficult in relation to the deer industry which at the farm, regional and national levels from the very beginning in the early 1970's has shown rapid and progressive growth.

3.1.1 The dairy sector

The NZ dairy industry has established a productivity target in order to protect its competitive advantage (Bodeker and Anderson, 2001). The most likely way a dairy farmer will achieve a productivity increase is by combining increased milk production while decreasing farm working costs. The dairy sector is working through a system called Total Factor Productivity (TFP) which is an economic measure covering the dairy farm, dairy manufacturing and marketing. TFP is calculated as an output over input calculation where a ratio of 1.0 means status quo (neither growth or shrinkage), a figure above 1.0 means growth and below 1.0 means that a business is not covering the costs of what it is producing (Bodeker & Anderson, 2001). It has been shown that about half the variation between farms in TFP is accounted for by economic farm surplus (van der Poel, 2001). It is somewhat disturbing within the dairy sector to find that TFP has been below 1.0 in every year since 1985 and in many years has been around 0.75. Some of that can probably be attributed to the high value of dairying land. Leslie (1999) has commented that "spending on supplementary feeds, fertiliser, wages and animal health have all increased substantially, at a rate which far exceeds growth in farm revenues".

3.1.2 The wool sector

Profitability increase in the wool industry is seen as a function of improved prices for wool and/or improved productivity. The productivity component is seen to need increased outputs (better sheep performance/breeding and/or better farm management) and reduced

costs (reduced input prices and/or reduced overheads) (McKinsey & Coy, 2000). Sheep productivity gain has averaged about 1%/year over the last 20 years and growers have not been able to raise their productivity to overcome a declining wool price (McKinsey & Coy, 2000). The report believes that on-farm productivity increases should be aimed at 5%/year with growers who "want to keep up with their competitors in substitute fibres, and stay ahead of long term real price declines" (McKinsey & Coy, 2000). Performance variation between sheep/beef farms in profitability is enormous and McKinsey (2000), using Meat & Wool Economic Service data, has calculated that 30% of farms are double the average or better in farm profitability while the same percentage are losing money. Several successful NZ growers have been able to achieve gains of 3-6% in productivity over an extended period of time and this will continue even if prices decline over the long term in real terms (McKinsey, 2000).

3.2 Components of productivity

Productivity is ultimately a ratio of output to input and is only useful as a guide if the numerator reflects a desired objective and the denominator a limiting constraint (Upton, 1989). Factors such as reproductive rate, deer growth rate, velvet antler production, wastage rate and stocking rate all impact on the outcome of productivity. *The biological components of productivity such as breeding and feeding warrant a review in their own right.* The present section of the productivity review is very generic and quite superficial.

3.2.1 Reproductive rate

There is very good agreement between information from Deer Master (2001), Richmond-Wrightson deer performance project (Walker *et al*, 2000) and Massey University (Wilson and Audigé, 1998) about reproductive rates in red deer (Table 1). Mixed age red hinds can be expected to wean about 87 calves/100 hinds to the stag. Rising 2-year red hinds can be expected to wean about 71 calves/100 hinds to the stag with extreme variation between farms. Recent research into the extent of introgression of wapiti genes into the NZ "red" deer breeding herd suggests that even at low levels of introgression (<20%) there is a significant reduction in first calving performance which is greater in those animals which have more wapiti genes.

Mixed age red hinds show a high proportion conceiving before 17 April and about 25% before 1 April. In rising 2-year old red hinds very few conceive before 1 April and more than half conceive after 17 April (Deer Master, 2001; Walker *et al*, 2000). A conception date of 1 April means calving about 18 November. There is much scope, particularly in yearling hinds, to advance mating date to early March and therefore calving date to late October/early November.

There is no evidence to suggest hinds mated to either red stags or elk bulls consistently differ in their reproductive performance (Deer Industry Manual, 2001).

3.2.2 Deer growth rate

Rate of growth to slaughter is of fundamental importance in assessing productivity because rapid growth and early slaughter will minimise the input of feed/kg carcass weight. Important periods of maximum variation between farms in deer growth rate are late lactation and in the autumn after pre-rut weaning.

Table 2 indicates that there is a very wide range in calf growth performance especially in late lactation and in the autumn. Calf weight at 1 June gives a very good indication of time to slaughter because winter and spring growth rates show limited variability as a function of feeding. Focus on nutrition during late lactation and during the autumn will be very important as the deer industry moves more towards year-round supply of chilled venison to European markets.

3.2.3 Velvet production

Velvet antler revenue to NZ comes from two sources:

- specialist velvet antler herds
- velvet antler from sire stags

Quality and yield per stag, taking into account animal age and culling rate, will have gone up substantially during recent years with the widespread use of performance recorded European sires. It is unfortunate that statistical information to document rate of change in velvet yield does not seem to be available. The proportion of super A and A grade in the national pool has gone up from 12% to 24% in the last 5 years (Deer Industry Manual 2001).

It has been shown that selecting stags into the adult velvet herd can best be done from the yield of the 2-year old head but that very useful prediction of future yield can be made from circumference measurements on yearling spikers.

Unless there are major scientific gains in demonstrating efficacy of velvet antler products or extracts from them in terms of human or animal health/performance in order to kick-start new industries, velvet antler will continue to be a very minor component of deer sector revenue. It is currently worth little more than skins and co-products (GIB Annual Report 2000 – 2001).

3.2.4 Animal wastage

Productivity reduction will occur through elevated death rate and debilitation of animals from diseases such as Johnes. Quantification of these issues is difficult and is the basis of a separate Animal Health review.

3.2.5 Stocking rate

Productivity is partly a function of feed consumed and the number of animals/hectare of farmland. Table 3 shows the seasonal feed requirements of hinds and stags across seasons and in comparison with ewes. Mature stags have relatively high feeding requirements in winter, spring and summer while hinds double their feeding requirements in summer when compared with the other 3 seasons. As the average hind weight on a national basis is tending to rise with the use of large European red sires, the stock unit equivalent has probably increased to near 2.1 stock units. There are many deer farmers who have stocking rates with deer that are in excess of the information shown in Table 3, particularly in summer where hinds are rated as in excess of 4 stock units. Failure to meet feed requirements decreases rate of grain and productivity efficiency by extending the time to slaughter.

3.2.6 Animal breeding

Productivity has been changed by the use of European sires and by the use of elk/wapiti hybrids as terminal sires. Compared with red deer, elk–red hybrid weaners are on average 10.3 kg heavier at weaning (Deer Industry Manual, 2001). Judson and Nicol (1997) concluded that 60 – 80% of the difference between red deer and hybrids in liveweight prior to slaughter was evident at weaning. Some of the female hybrid progeny from terminal sire matings have been retained in the national breeding herd and this is believed to increase the non-pregnant rate in the animals at first mating (see section 3.2.1 in this review). Hybridisation of red deer females with males from strains 50% and 100% heavier than red stags resulted in increases of 11% and 21% respectively in biological efficiency as g carcass/MJ of ME feed intake (Fennessy and Thompson, 1989). Some of this improved biological efficiency has now been integrated into the NZ deer industry from the widespread use of hybrid stags as terminal sires.

The consequences of using large European red deer sires in the stud industry and the progeny being sold as commercial sires, is that the average hind weight has increased with concomitant increase in feed requirement. A reduction in stocking rate should follow this trend but in many cases this does not appear to be happening.

Table 1: Summary of red deer reproductive performance information for farmed red deer in NZ.

	Calves reared/100 mixed age hinds to the stags		Calves reared/100 rising 2-year old hinds to the stag	
		(Range)		**(Range)**
Deer Master (Deer Master, 2001)	85	(72-94)	72	(56-88)
Richmond-Wrightson project (Walker *et al*, 2000)	87	(68-93)	71	(11-92)
DeerSouth (DeerSouth report 1999) Massey University (Wilson & Audigé, 1998)	89	(69-94)	70	(50-88)
Average	**87**	**(68-94)**	**71**	**(11-92)**

Table 2: Growth performance in red stags from birth to winter (1 June)*.

Lactation of 100 days (g/d)				Autumn (g/day)	
First half		Second half			
	(Range)		**(Range)**		**(Range)**
540	(400-750)	370	(200-700)	185	(0-300)

* Source: Pollard *et al* (2000); Walker *et al* (2000); Deer Master (2001).

Table 3: Daily feed requirements of some classes of deer and ewes (MJME)*.

Age (years)	Autumn	Winter	Spring	Summer	Animal stock units
Stags					
0.25 – 1.25	16	21	27	26	1.5
> 3.25	19	36	42	38	2.2
Hinds					
0.25 – 1.25	15	17	22	21	1.2
> 2.25	23	22	24	47	1.9
Ewes (55 kg)	13	10	28	11	1.0

* Source: AgFact No 11.

3.3 Measurement of productivity and models to measure rate of change

Major messages from the dairy and wool sectors are that on average, net productivity is declining over time. The good news is that in both sectors there is extreme variation between producers in productivity with the top 20 – 30% achieving goals of at least 4% growth/year. The deer sector does not yet have the sophistication or database to establish its productivity level or assess rate of change.

The current deer industry strategy in relation to venison as the overwhelming industry product is to target the European sophisticated food end of the market with top quality (assurance assessed) chilled venison all year round. This strategy requires productivity measurement from the birth of the deer to an assessment of final consumer reassessment to the product and everything in between. It is feasible to consider the task at two levels while recognising that the levels are inextricably linked.

3.3.1 Level one: On-farm productivity

The following parameters need to be measured and addressed in a modelling approach through programmes such as the Priority Research Investment Model (PRIM) being used by the Meat Industry.

Stage	Measurement/Process
1. Conception	• stag and hind selection and genetics • fecundity • hind and stag health/condition • hind weight
2. Gestation	• embryonic and foetal survival
3. Birth	• hind nutrition • farm survival
4. Weaning	• fawn mortality • fawn growth rate • hind lactation • fawn health • trace elements • internal parasites

Stage	Measurement/Process
5. Post-weaning	• fawn growth rate • hind recovery to mating • farm survival
6. Pasture & feeding	• pasture production • pasture utilisation • pasture quality • trace elements • internal parasites • feed management • supplementary feeding • drought management • plant genetics/breeding
7. Farm management	• farm planning • performance recording
8. farm to slaughter-plant	• transport process (QA) • yarding/ramps • stock handling/holding/moving • procurement system • % ready for slaughter • time off feed to slaughter • % dead in yards • % dead on arrival • acute – mortem rejection rate • % bruise free

Note: Adapted from supply chain approach – Meat NZ through PRIM.

3.3.2 Level two: Off-farm productivity

The following parameters are relevant to productivity performance from the slaughter plant to the consumer and can be considered by a PRIM analysis.

Stage	Measurement/Process
1. Slaughter	• stunning • % contamination • MAF inspection • electrical stimulation
2. Skin removal	• hair contamination • % farm faults • % plant faults • % carcass tearing
3. Dressing	• evisceration • % bruise free • % detained • Tb status • weigh and grade • hot carcass weight • chill weight loss • fat trim (kg)
4. Bone and Cut	• trim • cut • bone • % dropped meat • % saleable from carcass • labour/kg • ACC incidence
5. Packaging	• chill or freeze • dispatch • overfill factor

Stage	Measurement/Process
6. Transportation to market	• tariffs? • pass quality regulations • pass import regulations • pass non-tariff barriers
7. Storage in market	• storage technology • shelf life
8. Distribution in market	• co-distribution • direct marketing • maintenance of infrastructure
9. Presentation, preparation and consumption; market research	• marketing plan • market promotion • branding • positioning • trend analysis • customer profiling • client feedback

Note: Adapted from supply chain approach – Meat NZ through PRIM.

The Priority Research Investment Model (PRIM) was developed by Hugh Barr in 1997 and the software attempts to define the requirements for the success of each participant at each end of the supply chain. The processes are identified that are necessary to make sure that those requirements are met at each step of the supply chain. The methodology attempts to benchmark the industry in each process in order to identify the gaps that exist between best practices, theoretical best practices and industry averages.

The level one productivity could best be established at the farm and regional level through the extended benchmarking project with some extrapolation to the national level. The MAF farm monitoring report methodology is valuable as a spot record of industry performance at one point in time. *The scheme is less successful in attempting to measure rate of change over time because the methodology used continues to vary over time.*

4. Current research on productivity

4.1 FRST programme

Contractual work covering 2000 – 2002 is being done under the title of "Systems for precise supply of high value animals products". The deer component of the work is focussed on assisting the industry to provide year-round chilled venison into up-market European cafes and restaurants which do not cater for traditional game dishes. The following is an overview of the components and in some cases progress is mentioned. The current contract will be completed by 30 June 2002. The outcome of a proposition to FRST for further science investment is not known at the time of writing.

4.1.1 Performance measures in the animal product supply chain: The work is linking knowledge about the venison supply chain from farm to customer to performance measures and sensitivity analysis. Progress has been made and documentation can be expected by 30 June 2002.

4.1.2 Simulation of supply systems: A venison herd model with mixed-age hinds has now been written which covers 2 years with the years commencing at the start of mating. The model needs to be extended to rising two-year hinds and rising-one year hinds and stags.

Programme framework

1. *Initial values and conditions set by user*
   - stag genetics
   - hinds suckling
   - weaning date
   - number of hinds
   - hind genetics
   - liveweight
   - age
   - body condition score

2. *Holes where data is needed*
   - time series data on growth of hinds and stags
     - different ME intakes
     - both sexes
     - red and wapiti
     - seasonal behaviour/rutting
   - time series on milk production
     - different ME intakes
     - combined with liveweight changes for hinds

- growth of wapiti calves to weaning
- growth of wapiti x red calves to weaning
- effects of nutrition on lactation
- effects of nutrition on fertility

Some of the field evaluation and refinement of the model is being done during 2002. More research to fill data holes will be done within a new contract for FRST yet to be confirmed. Concurrently we would expect the supply chain research to identify production and/or processing components of the chain that require more detailed systems research.

4.1.3 Technologies for overcoming seasonality in biological systems

4.1.3.1 Initial emphasis has been on overcoming the seasonal constraints of forage and reproduction in the context of new chilled venison value chains. Progress for 2000 – 2002 period will be summarised in June 2002 but some highlights are:

- extremely detailed behavioural data is currently being analysed that will greatly improve our understanding of successful mating in both mixed-age hinds and yearlings as well calving behaviour which will impact on finding practical ways of decreasing post-natal death in calves.
- post-rut weaning can improve autumn calf growth rate when compared with pre-rut weaning, but at the expense of delaying conception date in the hind for the next seasons calving.
- small amounts of wapiti in “apparently” red hinds seems to be associated with lowered reproductive rate in yearling animals.
- final studies on developing multiple-embryo transfer systems in red deer have been completed.

4.1.3.2 In the field of genetic improvement for the NZ deer herd the following are outputs from FRST investment in recent years:

- 3 papers published by Fennessy (1997 a, b, c) as part of a major theme on Genetics in the Deer Branch of the NZVA proceedings of that year covering issues of genetic improvement, mapping, markers, embryos, cloning and transgenics.
- A paper to the AAABG conference in NZ (Pearse and Amer, 2001) summarising the challenges and progress associated with developing a genetic evaluation system for the deer industry.
- A confidential report from Amer, McEwan and Pearse “Genetic parameters for seasonality traits in NZ farmed red deer” (2001). Two industry datasets were used to estimate genetic parameters for traits associated with supply of high quality venison in critical market periods.

- A report from Peter Amer "A model for estimating the economic importance of alternative seasonality traits in NZ farmed red deer" (2001). The model computes the relative economic importance of alternative seasonality traits in deer and predicts average growth rates and liveweights of a group of animals from birth to 2 years of age. One of the conclusions is that there is no economic advantage in improving weaning weight if a corresponding increase in yearling weight does not occur.
- A report that investigated the options for predicting velvet antler weight pre-harvest in 2-year old stags using velvet antler dimension measurements which can be taken at harvest, or intact on animals at the optimal harvest time. The prediction model was shown to have an accuracy of r^2 = 0.94. The research will be of enormous value to many stud breeders who do not wish to cut velvet antlers from their 2-year old stags for sale yet would like to have a good estimate of velvet yield.
- The provision of a sire reference and breeding evaluation scheme for a deer breeding society which has now been accepted for implementation.

4.1.4 Manipulation of product animal traits

Two scientific papers have just been accepted for publication giving the results of research into the manufacturing properties of deerskin. The physical properties of deerskin were found to exhibit very little in the way of variation between skins, between sexes, between slaughter times and also within skins compared to other sources of leather such as lamb. Age was found to be a significant factor limiting the usefulness of deerskin, as more scars tended to accumulate over time and the appearance of the finished leather deteriorated (Scobie, 2002). This work represents a starting point from which to expand future research that will underpin new fashion enterprises.

4.2 Variation in farmer productivity

Deer Master (Deer Master, 2001) and the Richmond-Wrightson deer performance project (RWDPP) were co-operative regional deer farmer projects where production performance was documented, analysed and through field days and workshops the outcomes have been promoted very successfully at the regional and national level. Data from these projects has been mentioned in section 3.2 of this review. Massey University developed a major project to study deer herd health and productivity which has been extensively covered in a range of scientific and industry publications (Audigé, 1995; Audigé *et al* 1995). A framework of risk factors has been developed to improve productivity.

Deer South is a benchmarking project where 40 farmers in Southland funded a performance recording scheme so that each farmer could see how his/her performance in a whole raft of parameters compared with the group median and the top 10%. The database

is being handled in a computerised scheme established by the AgResearch IT group. Of fundamental importance is the analysis of why the top 10% of performers are at the top and the uptake of the information by members whose performance is well down the ranking list. After 3 years Deer South has attracted strong support of motivated farmers who conservatively have achieved a 5-fold return on their investment. An example of group success is illustrated in improved pregnancy rate in yearling hinds. This has been lifted from 81% to 91% in 3 years over Deer South's group mean.

The group is developing on "efficiency of breeding" index which includes weaning rate of weaning weight per 100 kg of hind mating weight. This sophisticated approach will work well in productivity assessment of farmers running small red deer or those using various sizes of wapiti hybrids.

The following is a list of the performance data being collected in Deer South:

- Age – 6 classifications
- Breed – 8 classifications
- To calve (nos 2 year olds, mixed age)
  - condition score
  - calving date start, median
  - dry udders
- Fawn sex and weight – mid January, weaning
- Lactation pasture cover (first week Nov, Dec, Jan, Feb – kg DM/ha)
- Fawn deaths and losses (5 categories)
- R2 stags

  Start December
  - number
  - breed
  - weight
  - sold
  - killed

  Start February
  - number
  - weight
  - killed
- R2 stags – velvet (number, breed, grade, weight, Regrowth)
- Older stags – velvet (age, number, breed, grade, weight, regrowth)
- Spiker velvet (number, breed, grade, weight)
- Yearling hinds to stag

  Start December
  - number
  - breed
  - weight

  Start February
  - number
  - weight
  - condition score

    - condition score
    - stag breed
    - breeding system
    - joining date
    - back-up date
    - removal date
- Mixed age hinds to stag, same as for yearlings
- Autumn saved feed – last week May
    - area
    - cover yield (kg DM/ha; ME value)
    - forage crop
- Supplements (quantity; nutritive value)
    - hay
    - baleage
    - silage
    - grain
    - pellets/nuts
- Stags – autumn
    - number
    - breed code
    - condition score

Note: Specimen reports are attached (Appendix 1)

A Sustainable Farming Fund (SFF) project has now been approved which will enable the Deer South project to be extended to another five regions of NZ. A national approach will allow the variables of climate, geography and land capability to be analysed in detail and a complete deer industry production systems model to be developed. The expectation is that based on the methodologies used in Deer South, Deer Master and the RWDPP projects in relation to reproductive rate, animal growth rate and velvet production a national benchmarking project will be established. This could form the core of a scheme that would allow the industry to begin establishing farm productivity data and in the medium term to provide estimates of productivity gain.

Attachment 1 demonstrates some of the late recording and information outcomes from Deer South.

4.3 International research on productivity

There have been a number of pieces of "component research" in UK (e.g. Davies *et al* 1998a; Davies *et al* 1998b; Vigh-Larsen & Davies, 1994) Australia (Flesch *et al* 1998; Tuckwell, 1998) and Canada (Haig & Hudson, 1993) but there is very little of this information of direct benefit to the database and relevant to NZ deer industry productivity. Improvement in future productivity will partially depend on generic scientific progress in fields such as reproductive technologies and nutritional understanding (e.g. reduced methane production). It is essential for NZ scientists who have expertise in deer science to be involved with the global science scene and to establish improved communication links between platforms in AgResearch as well as between research and teaching institutions.

5. Gaps in knowledge to achieve productivity growth

The deer industry has tended to focus on managing industry growth. This has largely been seen as balancing national herd growth through the retention of a large proportion of yearling hinds into the breeding herd, with the necessity to slaughter animals to meet venison market demands. Since there are no control mechanisms available to the deer industry bodies it has always been a source of some frustration that procurement of animals for slaughter has often been highly competitive between processors and a function of both live sales levels (demand for herd growth) and prices paid for velvet antler. Wildly fluctuating velvet prices have frequently distorted the availability of stags for slaughter. In 1998 the CEO of the Game Industry Board recommended an industry growth target of 10% in hinds and 5% in stag growth. He said that target was necessary "for a sustainable, manageable and profitable industry for all parties" (GIB Annual Report, 1999-2000).

A separate issue to overall industry growth is productivity growth on a per animal, per hectare or per unit feed basis. The deer industry has never had productivity targets in this context but would have enough knowledge about animal performance to establish them. There will be much difficulty in assessing performance in relation to targets and therefore equal difficulty in assessing rate of change in productivity. Productivity assessment needs accurate information on the age structure of a herd, age-specific reproduction, mortality and growth rates (Upton, 1989). The major problem for the deer industry is that productivity assessment really requires the use of a steady-state (stationary) herd model (Upton, 1989), a situation that is relatively meaningless to the deer sector which has had, and continues to have rapid industry growth. In 1990 there were about 1500 deer farmers and by 2002 this has increased to about 4500. The large increase in new entrants makes changes in productivity measurement difficult and suggests a necessity for farmer education. A more

pragmatic approach that could be taken by the deer industry is to focus on performance targets rather than productivity. This is an approach being taken by some sections of the dairy industry which is obviously much larger, more complex and has a very much larger database when compared with the deer sector.

5.1 Market analysis

In 1995 the Game Industry Board (GIB) published "Deer Industry Vision 2000, a document which came from consultation with the NZ Deer Farmers Association (DFA) and the NZ Deer Industry Association (DIA). The strategic industry vision re-affirmed:

- the aim is sustained profitability for the NZ deer industry
- developed in consultation with industry partners
- industry priorities shape the action programme

A key plank in the vision is the necessity to manage growth. "The NZGIB has no power to compel farmers, processors and exporters to adopt specific growth targets. It will work co-operatively with all industry sectors to encourage sustainable industry growth".

The GIB publishes a market report on a monthly basis (in association with the DFA Stagline production) and summarises current activity in the venison and velvet markets. The report goes to all deer farmers and is a major source of communication about market information.

Formal market analysis for the deer sector cannot occur because all the export business is conducted by commercial processors and exporters who for obvious commercial reasons do not want to publicise their knowledge and strategies even, in some cases, to their own shareholders. The GIB, therefore, has an extremely important function in translating some "sensitive" market information it might obtain into a broad picture for the benefit of deer farmers. **Research people largely work in a vacuum in relation to market and customer analysis.** A mechanism should be established to overcome this deficiency and it could be facilitated by DEEResearch. If new venison products and presentations are to be successfully developed by science and technology then foresight and market analysis needs to be part of the mix.

5.2 Herd growth and animal harvest rate (see Table 4)

5.2.1 Stag numbers have grown from about 100,000 in 1985 to 580,000 in 2000. The 1.24 million hinds in 2000 will need about 50,000 sire stags and the rest of the stags are farmed for velvet antler. The world market for traditional velvet antler is about 550 tonnes of undried product and it is extremely price sensitive to increase in volume. Wildly fluctuating prices paid for velvet antler over the last 10 years have had two effects:

1. produced huge variation in the numbers of culled stags presented for slaughter from one year to the next.
2. produced big variation in industry carcass weight as a function of heavy weight carcass from culled velveting stags.

Table 4: NZ Deer Industry Growth Rate (Dept. Statistics)

	Number of hinds ('000)	Number of stags ('000)	Farmed venison* (tonnes)	Velvet antler (tonnes)	Velvet antler price ($/kg)
1980	65	40	139	19	129
1985	212	108	1580	57	73
1990	636	340	4960	274	160
1995	710	454	21,340	558	124
2000	1,264	579	22,307	450	114
2005 *(Estimate)*	1,810	847	40,410	686	80

*** This is carcass weight at the slaughter plant, not export weight.**

The industry has always had great difficulty in managing venison and velvet antler supply. The two are inextricably linked and management continues to pose a major challenge.

5.2.2 Hind numbers have increased dramatically from about 200,000 in 1985 to 1.26m in 2000. As confidence in the industry has fluctuated with time, the strength of the market for live sales has been very volatile and therefore numbers of hinds presented for slaughter has been unpredictable. In a reverse effect to that with stag statistics an increase in hind slaughter rate has tended to push the average national carcass weight down. The GIB has consistently urged the deer industry to limit hind herd growth to no more than 10% per year in order to maintain consistent supply to the venison market. In spite of this, growth rate on many occasions has been in excess of 15%/year.

MAF, using Statistics NZ data, uses a deer model to summarise information and to estimate future growth in animal numbers and in product volumes. One of the key parameters that always causes problems for MAF is to estimate the replacement rate for weaner hinds. The deer industry should work closely with MAF and Statistics NZ to improve the quality of industry database and its use for future predictions.

5.3 Limiting factors to animal performance and farm production:

- low and variable reproductive performance from first calving hinds.
- incorrect stocking rate of deer on many farms resulting in "under prepared" deer being presented for slaughter (pers. com. from a DSP manager). Education about the seasonal feed requirements of deer and pasture productivity is required.
- relatively high neonatal mortality.
- diseases such as Johne's which can cause mortality in some young deer and poor performance from many more.
- uncertainty in relation to product prices. Forward contracts at agreed farmer returns are available but high spot prices offered from competitors seeking to increase market share often mean that contracts are broken.
- poor performance in growth rate between pre-rut weaning and the winter.
- inadequate animal growth rate in the "winter-cold" areas of NZ from the third week in August until spring pasture growth exceeds animal demand (often early October in the southern districts of the South Island). In rising yearlings the appetite drive in late August is often not met by sufficient quality feed.
- inadequate management to maximise year-round utilised pasture quality and quantity. Current workshops directed at the lamb and beef sector and funded by Meat NZ would be very valuable to the deer sector.
- a lack of genetic progress through performance recording and the use of estimated breeding values with particular reference to venison production.
- quality feed to lactating hinds during the second half of the birth to pre-rut weaning period.
- uptake by the majority of deer farmers of "best practice" farming methods as documented in benchmarking projects.
- a lack of understanding of important components of multiple ovulation and "in vitro" production of embryos in order to spread the superior sires and dams more widely in the deer industry.
- better appreciation of future requirements from international consumers of venison so that new product lines and formulations can be established.

6. Capability summary

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- Dr Mike Tate, Animal Genomics, Invermay

6.2 Abacus Biotechnologies, Dunedin

- Dr Peter Amer
- Dr Neville Jopson

6.3 Massey University

- Professor Tom Barry, Institute of Veterinary and Biomedical Sciences
- Professor Peter Wilson, Institute of Veterinary and Biomedical Sciences
- Dr Simone Hoskin, Institute of Food, Nutrition & Human Health

6.4 Lincoln University

- Dr Graham Barrell
- Dr Alistair Nicol
- Professor Andrew Sykes

6.5 University of Otago

Professor Frank Griffin

6.6 Pyne Gould Guinness

- Dr Glen Judson

7. Research priorities in relation to productivity

The list falls into 2 categories:

- Those addressed directly to DEEResearch Ltd.
- Those that should be addressed by the wider industry.

7.1 Topics for DEEResearch Ltd

7.1.1 Commission a review to look in detail at the areas of reproduction, nutrition, management and breeding.

This review will establish research topics and priorities in the fundamental farm production areas of feeding, breeding and management.

7.1.2 Develop a mixed-age hind model which includes rising 2 year-olds and yearlings so that industry growth can be more precisely assessed. The approach should involve discussion with the policy analysis group at MAF.

7.1.3 Using the sub-models of growth, lactation, reproduction, establish gaps in our knowledge which need specific biological research to fill.

7.1.4 Extend the "deerskins for fashion garments" research work already being done by AgResearch/Otago University so that improved returns can be achieved from the large increase in skin number about to occur (slaughter numbers are expected to approach 1 million by 2008 compared with the current ½ million).

7.1.5 Establish pasture management/quality workshops in the important deer farming regions as a component of growing productivity.

7.1.6 Develop a science/industry strategy to implement an "estimated breeding values" programme into the heart of the deer industry.

7.1.7 Foster a climate of good communication between groups that have deer science capabilities.

7.2 Topics for the wider deer industry

7.2.1 Establish a means of measuring national velvet antler production (weight and grade).

7.2.2 Use an adaptation of the PRIM software (discuss with Meat NZ) which can be used to establish requirements for success of each participant in the chilled venison supply chain. Areas of greatest sensitivity should be priorities for DEEResearch Ltd.

7.2.3 Establish industry performance growth targets with a timeline.

7.2.4 Find a process that will establish future venison market opportunities that are much more specific than those currently available and combine this with foresight investigation of future food trends.

7.2.5 Work with Dept Statistics and MAF to improve the industry statistics database and growth predictions.

7.2.6 Encourage "economic farm surplus" recording in benchmarking and similar projects to document changes in productivity over time.

7.2.7 Foster the national benchmarking project (development from Deer South, Deer Master and RWDDP) as a major method of technology transfer and productivity gain.

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9. Contributors to the review

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