# Managing fallow deer (*Dama dama*) and red deer (*Cervus elaphus*) for animal house research

**ANZCCART Facts Sheet**

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## Domestication

Domestication of deer commenced centuries ago in Asia and Europe, particularly in China, where deer were farmed for velvet production, which is used in traditional medicine. In Europe, however, farmed deer were mainly used for game meat (Hudson, 1999; Mackay, 1985; 1998). It was not until the 1970s that there was a growth in deer farming in western countries, coinciding with a depression of the beef industry (Mackay, 1985). Today deer are farmed in large paddocks where they run freely behind 2 m fences. Farmed deer adapt readily to routine handling and hand feeding, but can be fractious if not accustomed to human presence.

## Species

While there are more than 40 recognised species and numerous subspecies of deer throughout the world, many are not suitable for modern agricultural husbandry and must be kept in an open environment. Farmed deer in Australia are limited to five species. Red, fallow, rusa and chital are the most popular farmed species, with only a few farms using sambar deer. The number of farmed deer was estimated at 2000 on 300 farms in 1985 (Mackay, 1985) and 160,000 in 1998 (Mackay, 1998). In 2001 there are probably about 250,000 deer on farms in Australia. Of these 40% are red, 50% are fallow with 10% of other species. Fallow deer are the only species in Tasmania, while red deer are probably now more numerous in New South Wales, Western Australia and South Australia. In Queensland, red deer are also very popular, with smaller numbers of rusa and chital deer. The number of red deer has increased dramatically in South Australia during the last few years. Farmers in the different regions select specific species based on climate, personal preferences, availability and market demand for products. Recently, cross breeding, in particular wapiti stags crossed with red deer hinds and European fallow crossed with Mesopotamian fallow, has been used to increase body size and growth rate. The cross bred / hybrid grows quickly and allows seasonal markets to be tapped earlier (Fox, 1996; Tuckwell 1998).

## The deer industry

The world deer industry is growing about 20% annually and today there are about five million deer being farmed (Hudson, 1999). In recent years, deer have been farmed on better-quality grazing pasture. Supplementary feed is required when the pasture is poor in quality (Mackay, 1998) and limited in quantity. Specialised fencing and handling facilities have been used on deer farms to cope with the agility and jumping ability of deer, which can clear 2 m fences or higher (Mackay 1998;Spiers and Yerex, 1987). Deer farms are designed such that deer can be moved along laneways connected to paddocks and to the handling yards. While it is recommended deer holding yards be under cover to enable easier handling in subdued lighting (Mackay, 1998; SCA 1991), most farmed deer are held in open yards. To reduce the stress on deer it is suggested they are trained to move into the yard themselves by providing feed in the yards on a regular basis. Yards enable deer to be drafted, vaccinated, weighed, velvetted and loaded. Commercial crushes are commonly used to restrain deer without difficulty.

## Deer production

The main products produced from deer are venison and velvet antler. The major consumer of venison in the world is Germany with 40-50,000 tonnes of venison consumed annually. The other major markets for venison are in Asia, while domestic sales are increasing in Australia and New Zealand. Deer are the only species which produce velvet antler. The estimated production of green velvet antler will be approximately 3,000 metric tonnes as the world population of farmed deer approaches five million (Hudson, 1999; Mackay, 1998). Good quality mature red stags can yield 3 kg or more of antler and up to 1 kg per year for fallow (Tuckwell, 1998). Venison animals are slaughtered at 12 to 24 months of age with carcase weights ranging from 22-32 kg for fallow, up to 48-65 kg for red deer and higher for wapiti hybrids.

Puberty occurs in fallow deer at about 28 kg, but fawning rates are low at that body weight. Over 75% fawning rates can be achieved if pre-rut weight is a minimum of 38 kg. Mature does range in weight from 42 to 50 kg and have weaning rates of over 90% (Smits and Haigh, 1990). The minimum breeding weight for red deer is 65 kg, but the target joining weight is 80 kg. Research has shown that an increase in hind weight of 50% in red deer (from 60 to 90 kg) can result in a doubling of the number of calves that are born and survive. Farmed red deer can achieve 85% weaning rates, with weaning rate largely influenced by management practices (Tuckwell, 1998).

## Animal house research

Deer are ruminants and considerable thought must be given to ensure they receive diets suitable for optimum growth and reproduction. When pasture availability is low, an economic supplementary feeding strategy is required. However, supplementary feeding for deer production is either often commenced at the incorrect time or does not meet the animals' requirements,

resulting in significant additional costs for the industry. To develop an economic supplementary feeding strategy, it is essential to understand the nutritive value of feeds commonly used by deer. To be able to determine the nutrient requirements of deer there is a need to house the animals indoors to enable accurate measurement of forage and water intake and faeces and urine production. However, farmed deer are normally maintained in groups in paddocks. The deer housed indoors are faced with short-term social isolation, which may be stressful and deer will elicit escape behaviour (Fox 1996; Hanlon *et al*., 1997; SCA, 1979 / 1980).

**Selecting deer for animal house research**

Despite the common perception of deer not being able to adapt to indoor housing, successful adaptation of deer is possible. Newly weaned deer selected for research are easier to house indoors. Sex, age and bodyweight are important factors when selecting deer for research. Due to the similar digestive capacity between the male and female it is easier to collect faeces from male deer (urea and faeces are easier to separate) than female deer for digestibility trials. However, stags are extremely aggressive during the rut (Tuckwell, 1998) and castrated deer are often selected. In any growth trials, the difference in growth rate between male and female should be taken into account. In Southern Australia, most red deer calves or fallow deer fawns are born during the first two weeks of December. Actual age of deer selected for research trial could be inaccurate if the assumption is made all fawns are the same age, particularly if selection of animals for research is delayed until most fawning has been completed. The deer with body weights close to group means should be selected for experiments.

Selection of deer for research should be carried out carefully. Deer should be handled through progressively smaller paddocks and then into pens. Sufficient pens must be available before entering a race and crush to enable the stock to be separated into groups without injuring each other. If animals are being held for a few hours awaiting handling, about 1.1 $m^2$ of space is required for each adult red deer. Once the animals are closely confined in a crush or initial holding pen, less space is needed. Calves up to six months of age can be accommodated with a space allowance of 0.3 $m^2$ per animal. Calves of six to nine months old require 0.4 $m^2$ and those nine months old or over 0.5 $m^2$ per animal.

Extra care is required during the rutting period when selecting or moving deer between paddocks. Once the rut starts the males become very aggressive. Young fallow bucks reach the rutting stage before the old bucks. Entire male deer may lose much of their fear of man during the rut, and can inflict serious injuries, even death to handlers. Male deer should not be hand reared, as these individuals are likely to be more dangerous when rutting as they see man as a rival and an equal. Rutting red stags are more dangerous to handlers due to their bigger body size (English, 1984b). Rutting can last six weeks for red deer.

**Transporting deer**

Laneways which connect with the paddock should be used to move the deer into the handling shed. The crush should have a drop away floor, and the top third of the side panels should fold down to give the handler easier access to the animal. The front and rear doors of the crush can be either sliding or hinged. The deer are usually transported in a covered deer trailer to maintain the animals' under low light conditions to keep them calm and to make handling easier (SCA, 1991; Mackay, 1998).

If there is a need to transport deer over a long distance from commercial deer farms to a research site, the preparation for transporting includes feeding them once during the night and again in the early morning. The deer can then be loaded into a covered deer trailer. For young calves or fawns, a roadside feed of warm re-constituted milk may be required, depending on the distance and time. The regular feeding of deer in holding yards close to the loading ramp will condition deer to yarding and reduce the stress on deer prior to transport. It is preferable, however, not to transport very young deer.

**Housing in pens**

Deer can be suitably housed in pens and it is possible to house both the red and fallow together if separate pens are not available. The Animal Research Centre at Roseworthy Campus, University of Adelaide has a deer holding facility with a raised floor approximately 3 metres above ground level. A 7 m x 7 m compound was constructed around the four posts in the middle of the building with 1900 mm ring-lock fence strained 100 mm off the floor giving a 2 m high fence. A double gate for access to the enclosure was installed in one corner. On the short side of the compound the fallow stalls were erected so that the ring lock fence acted as the back wall of the stall. The red deer stalls were erected on the opposite side of the compound to give more space for larger stalls. Six stalls for red deer and six stalls for fallow deer were built within the compound for digestibility trials. The compound (7 m x 7 m) in an animal house should provide enough space for the 6 red and 9 fallow deer to walk without restriction. The height of the compound should be about 2 m and covered all round with hessian to give deer privacy and to avoid startling the deer when handlers enter the animal house. Initially, red and fallow can be housed in the same pen and the lights turned off for two days after being introduced to the holding area, to help the deer to acclimatise to the new conditions under minimum stress.

**Monitoring behaviour**

It is beneficial to record deer behaviours via video for the first 10 days after introduction of the deer into the indoor housing. This enables a record to be kept of their behaviour during periods when staff are not in attendance. An infra red video camera linked to a video recorder with ultraviolet illuminator will give a good video recording of animals both during the day and the night. The behaviour of deer can be recorded on video in real time or time lapse.

**Deer-human relationship**

Staff should at first move slowly and talk quietly to the deer to let the deer feel that the handlers are not a

danger to them. Handlers should avoid shouting or waving their hands at the deer. Fresh lucerne and grain should be used to train deer and enable staff to hand feed the deer. Patience is needed in handling deer to avoid injury to both staff and deer. It is important to hand feed deer daily for the first 10 days using the same staff dressed in similar clothing to help deer adapt easily to the handlers and new housing. Fresh cool water should be available at all times.

It is important to move slowly and quietly when approaching the deer because they are very sensitive to sound and to unusual and sudden movements. Children and short people seem to be less threatening to deer, but deer may react aggressively toward strangers. They walk aggressively towards the stranger, and sometimes raise on their hind legs and strike out with the fore feet. Experience from the Rowett Research Institute shows that red hinds appear to be more aggressive to children. Extra care should be taken when handling hinds at calving, as they can be extremely dangerous. In addition, when the velvet of the antlers is fraying and prior to the rut, stags' behaviour is extremely unpredictable (Blaxter *et al.*, 1974). It is not prudent to turn one's back on any deer in a small enclosure.

Anecdotal reports indicate that dogs can cause severe stress for deer. On occasions, deer will be very aggressive towards dogs. Experience at Roseworthy indicates that exposing deer to dogs early in the fawning periods enable the two species to interact without conflict.

**Stalls**

Individual stalls were built for a digestibility trial at Roseworthy (figure 1).

Stall dimensions for red deer were 1800 mm long x 1950 mm high x 1200 mm wide. The walls and doors were constructed of pine timber frame and exterior ply sheets fixed with waterproof glue. The timber used was 75 mm x 40 mm in 5 or 6 m lengths. The exterior ply sheets were 1200 mm x 2400 mm x 7 mm. The timber was cut to the desired lengths to make the frame and joined with gang nails. The ply was cut to the frame size and 8 g x 40 mm wood screws were used to fix the ply to the frame. Holes were cut in the walls and doors so the animals had eye and nose contact with each other. There were three rows of holes cut staggered at 100 mm in diameter, about 900 mm off the floor.

Stalls for fallow deer were built using the same method of construction. Their sizes were 1200 mm long x 1950 mm high x 900 mm wide. The same material was used for the walls and doors. The 100 mm holes were cut in the same pattern only 700 mm off the floor. The feeder was fixed on the door with the water bucket next to the feeder so that the handler did not need to access the stall. A faecal collection net was placed underneath each individual stall, similar to the faeces and urine collector used in metabolic cages for sheep.

**Collecting samples of rejected feed and faeces**

The raised floor had a 90% shade cloth net underneath to collect the faeces. The shade cloth was cut to the perimeter size of each stall in the shape of a cone. Eyelets were inserted around three sides of the cone and this was fixed to the under-side of the pen using cable ties. The open side of the shade cloth structure was threaded with small rope, gathered up and tied to the floor to form a bowl to hold in faeces during collection periods. This is different from faecal collection from sheep using faecal bags, but causes significantly less stress to the deer. One problem is that the hair of deer can contaminate the faeces. The hair should be picked out before sampling, or could be blown away with a hair drier after the sample is dried. The faecal samples should be stored at –10 °C. The feed residue should be collected every day and weighed during the collection period.

**Blood sampling**

The best method of restraining deer for blood sampling or other procedures is to use a drop floor or hydraulic crush. After deer are restrained in the crush blood samples can be collected by jugular venipuncture into evacuated glass tubes containing either dipotassium ethylene-diaminetetraacetic acid or no anticoagulant (Wilson and Pauli, 1984).

**Blood constituents of red and fallow deer**

Many blood biochemical parameters are potentially useful as diagnostic aids for many disease conditions of deer, with published reference values for all common species (English, 1992). While the values obtained from immobilised deer are useful, age and sex of deer and sampling time are important factors influencing many haematological values. In general, the values of haemoglobin and packed cell volume are higher in deer compared to sheep, goats and cattle (Blaxter *et al.*, 1974), but the sampling technique can affect these parameters. For example, samples collected from fully conscious deer are likely to produce higher haemoglobin and packed cell volume values than from tranquillised deer (Wilson, 1984b).

**Behaviour of deer in the animal house**

*Species interaction*: Red and fallow deer do not usually engage in fighting. However, when red deer are eating they may not allow fallow deer to approach. Fallow deer tend to eat when the red deer are sitting. Fallow and red deer spend similar amounts of time walking, foraging, sitting, drinking and grooming in the animal house pen. During the afternoon in the initial four-day acclimatisation period, fallow deer tended to spend more time engaged in these behaviours compared to red (except for sitting).

*Acclimatisation*

0-4 days: During this period of acclimatisation, there was no difference in foraging, drinking and grooming time, although walking, sitting, standing and feeding time did vary on some days.

0-10 days: When the data were summarised over the 10 day acclimatisation period, there were no significant differences during the day between fallow deer (1602.3 ± 64.70 seconds) and red deer (1433.5 ± 107.12 seconds) in sitting time, although the red tended to be more active than fallow deer engaging in more walking, foraging, standing and feeding (figure 2).

**Chemical restraint of deer**

Chemical restraint of deer is useful in specific situations, but there is considerable variation in the

**Figure 1. Layout of the stalls for housing deer in the animal house**



**Fallow deer housed in stalls**

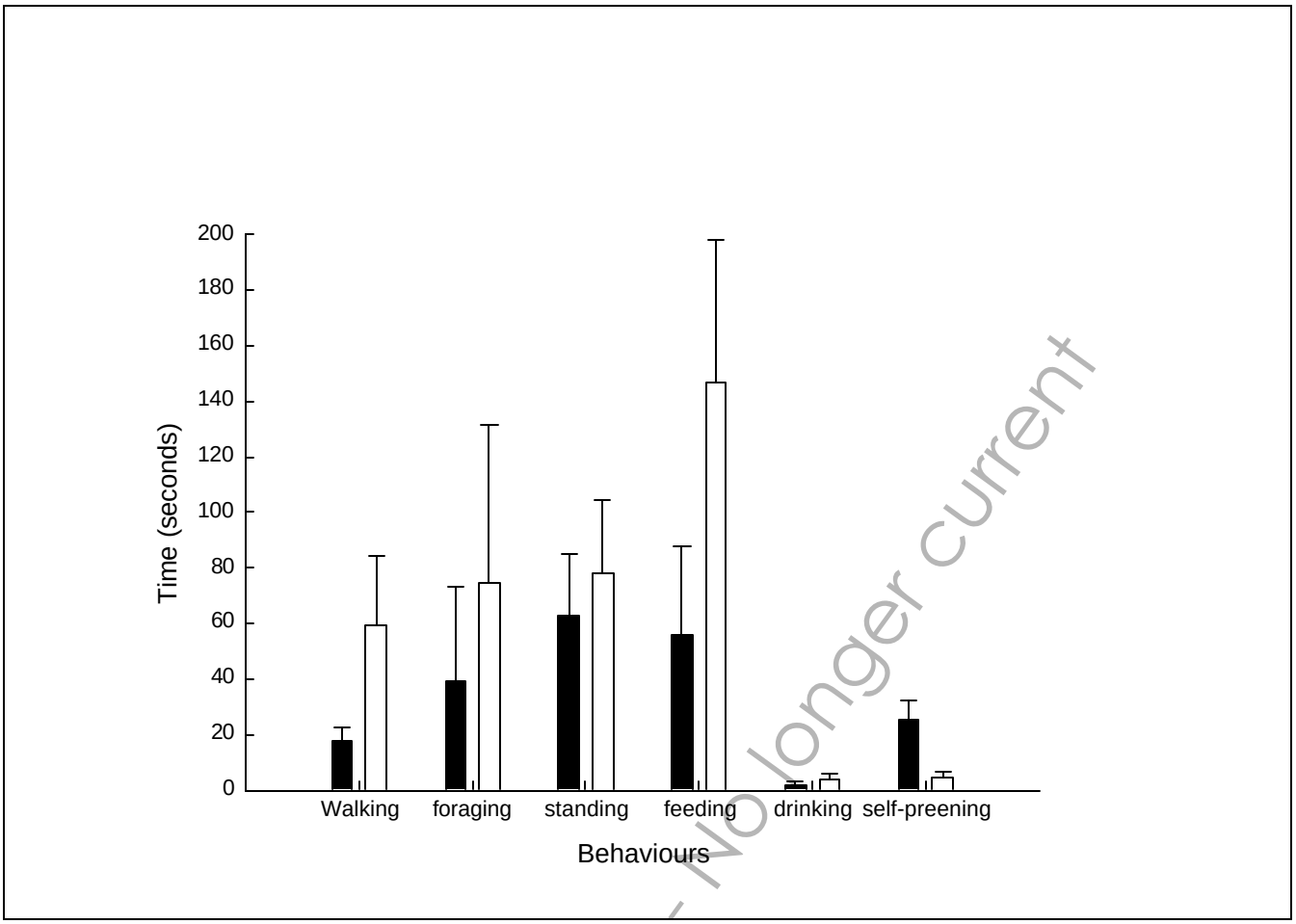




**Figure 2. Average time (Seconds) fallow (n) and red (ž) engage in behaviours measured over 6 periods (30 minutes/period) in one day (means ± s.e.)**

**Red deer**

drug doses between species and between individuals. The actual amount of drugs used is also dependent on the age, sex and body weight of the deer, and careful evaluation of the deer should be made before implementing chemical restraint. Administration of the drug is best carried out by injection using a hand syringe (on a deer in a crush) or by projectile syringe on deer in pens. Some sedative drugs such as diazepam can be administered in the feed, but this is a less reliable method.

Oral administration is not a reliable method because of the wide variation in the amount of drugs actually consumed by individual deer, especially in group pens where dominant individuals generally take more feed. The drugs used in this way include diazepam, acetylpromazine maleate and haloperidol. Haloperidol can be used at 0.2-0.3 mg/kg for fallow deer, and diazepam at 28.6-31.7 mg/kg liveweight for fallow deer.

The injection can be administered using handheld syringes, pole syringes, blowguns or power-projected syringes. However, the safe target area on a deer is dependent on the type of syringe used and the size of the individual deer. For most deer, the preferred target is the large muscles in the area behind the femur but the shoulders and in the neck may be acceptable. For fat animals, there is a risk of injecting the drug into adipose tissue, which results in erratic drug effects. It should be remembered that projectile syringes should not be fired at moving animals. Of the drugs available, the Hellabrun mixture of xylazine 125 mg/ml/ketamine 100mg/ml is commonly used for fallow deer with the following doses recommended by English (1984a): Adult bucks (>75 kg liveweight): 2 ml; Young buck (50-75 kg liveweight): 1.5 ml; Yearlings (30-50 kg liveweight): 1.0 ml and adult does (35-45 kg liveweight): 1.5 ml.

Red deer can be immobilised with a range of drugs and are readily restrained for procedures such as velveting by the use of xylazine alone, at dose rates between 0.5 and 1.0 mg/kg intramuscularly. Analgesia then needs to be achieved using local anaesthetic. The dose rates of the Hellabrun mixture are 2 ml for mature stags, 1.5 ml for yearlings, and 1-1.5 ml for hinds. The effects of xylazine can be reversed using yohimbine intravenously at 0.25 mg/kg.

**Anaesthesia of red deer**

*Pre-anaesthesia*

Deer can be housed in an individual stall with solid wall and door, and with sawdust on the floor. Do not use a straw-covered concrete floor because it becomes slippery. When approaching and applying physical restraint, handlers should quietly talk to deer and wear a helmet to protect their heads. The handler should also be aware of biting and kicking. Before anaesthesia, deer should be fasted for 12-24 hours, with water available.

*Anaesthesia*

The deer should be restrained in lateral recumbency on soft mats and a blindfold placed over its eyes. The deer is relaxed while the jugular is clipped and an indwelling catheter inserted. The deer is sedated at about 0.5 mg/kg xylazine and induced with a mixture of valium and ketamine intravenously. Then the deer is intubated and maintained with halothane (1-1.5%) oxygen or halothane/nitrous oxide/oxygen, with an oxygen flow rate of 2 litres/minute. The deer can be intubated using only xylazine, but muscle relaxation is not good (Wilson personal com.). The induction agent can also be glycerol quaicolate as a 5% solution in saline (Wilson, 1984a).

*Anaesthesia of small callves and fallow deer*

Young deer usually do not struggle as much and can be more easily handled. The small calf can be masked with a mixture of halothane and nitrous oxide for induction. Intubation can be carried out using a laryngoscope and anaesthesia maintained using halothane/oxygen. Fallow deer can be sedated with xylazine at about 1 mg/kg. The same method can be used for red deer (Wilson personal com.).

**Recommended protocol for velvetting**

There is no place for full hard antlers on farmed deer. There are a variety of methods available to achieve this, including surgical polling, hard antler removal, velvet antler harvest or castration (for deer destined only for slaughter). The commonest approach is probably to remove velvet antler at a time that attracts the best price for this product. Any interference with the growing antler requires effective analgesia, with serious animal welfare concerns if this is not done. The options for analgesia are summarised by English (1988).

**Diseases**

The clinical signs of acute disease include dullness and depression, loss of interest in avoiding being handled, standing away from the herd, victimisation by other deer, and drooping of the head and ears. The following is a brief summary of some common diseases. More detailed information on diseases, diagnosis, pathology and treatment has been reviewed by English (1992) and Haigh and Hudson (1993).

*Parasites*

The commonly occurring parasites in the pulmonary system include *Dictyocaulus viviparus* and *Muellerius capillaris*. *D. viviparus* can be a problem on red deer farms in Australia and only occurs under intensive farming conditions, especially when animals have been set at a high stock density or returned to dirty pastures after drenching. This parasite is more severe in young animals of 3-6 months of age. Cattle are considered to be a source of this parasite for deer. The infected deer often lose body condition, with poor growth rates and rough coats. To prevent *D. viviparus*, deer should be monitored regularly and when required drenched with a common anthelminthic and rotated onto clean spelled pastures. While sheep are believed to be the source of *M. capillaris* in red deer, the effect of *M. capillaris* is negligible.

Parasites in the gastrointestinal tract include many species and clinical effects are more pronounced in younger animals. The infected deer show poor body condition, low body weight gains and loose faeces. To prevent these parasites, animals should be monitored regularly and drenched when required and rotational grazing incorporate into the farming management system.

The common liver fluke *Fasciola hepatica* has been identified in feral deer, but not as commonly in farmed deer. However, on deer farms with a higher stocking density, liver fluke could be a serious problem if the conditions were suitable for the parasite. The infected animals can be treated by using fasciolicides.

Sarcosporidiosis has been reported in some red deer herds, with the parasite locating mainly in the abdominal musculature and diaphragm.

Babesiasis occurs in cattle in Australia and may also occur in deer. There are no reports of the clinical signs in deer, indicating that babesiasis may not be a problem for deer in Australia.

Lice occur frequently on farmed deer and could be a problem in young animals or on animals in poor body condition. Ticks have been found frequently on both farmed red and fallow deer, especially in summer. These infestations could result in poor quality velvet.

*Bacterial diseases*
Salmonellosis has occurred in farmed deer in Australia. The infected deer show anorexia, depression, listlessness, recumbency and opisthotonus. The treatment should be similar to that of sheep and cattle.

*Yersinia pseudotuberculosis* can be isolated from normal deer faeces and is recognised as a major cause of farmed deer deaths. Yersiniosis can occur on properties after severe drought or other weather stress, especially for deer in a poor nutritional condition. Hares, other free living animals and birds carry the organism, which can spread to deer by faecal contamination of pastures and feedstuffs. Affected animals appear depressed, anorexic, standing away from the herd, and dehydrated. The strategies for preventing this disease include the use of antibiotic-impregnated concentrate nuts and avoiding or minimising nutritional and other stress factors.

Tuberculosis occurs in New Zealand and the UK in red and fallow deer. Blaxter *et al.*, (1974) described intermittent diarrhoea in young red deer with tuberculosis. Wilson (1984c) suggested that any superficial or subcutaneous swelling in deer should be suspected as being tuberculosis. Only one deer herd in Australia has ever been diagnosed with tuberculosis, in South Australia in 1985.

Clostridial diseases include blackleg, black disease and enterotoxaemia. The last is more serious in farmed deer. These diseases can be prevented by the use of a specific vaccine or by multiple vaccines which protect against the major clostridial diseases.

Johne's disease appears to be easily transmitted to deer, and is now common in New Zealand. If deer are grazed in contact with other infected stock such as sheep and / or cattle, the condition can become endemic in some herds. Infected deer show weakness, emaciation, chronic intermittent scouring and a dry coat. If a farm is infected with Johne's disease in sheep or cattle, it should be de-stocked for long periods before re-introducing deer. Several cases have occurred in farmed deer in Australia, but there is no evidence to date that endemic infections occur on Australian deer farms.

*Viral diseases*
Malignant catarrhal fever has been reported for red, rusa and chital deer, through contact with sheep. This disease is invariably fatal in deer and cattle. The infected deer show blindness, circling, salivation and ulcers on lips and muzzle. There is no treatment.

Foot and mouth disease (FMD) has been reported in other countries in many deer species, but not in Australia and New Zealand. Feral deer could pose a problem in controlling the disease if FMD virus crosses from livestock, including farmed deer, into free-living deer populations. Feral pigs will undoubtedly pose a greater problem, however, should FMD occur in Australia.

**Current deer research and facilities in Australia**

The funds available for deer research in Australia have contracted sharply in recent years. As a result, a number of Institutes have either wound down research activity or are considering whether it is worth maintaining their infra-structure to conduct deer research.

*Deer research on the Roseworthy Deer Farm*
The Roseworthy Deer Farm is a joint venture with the South Australian Deer Breeders Association, The University of Adelaide and Primary Industries and Resources South Australia. The farm consists of 80 ha of land divided into 14 paddocks, some of which have been further subdivided for research purposes. There are about 400 fallow and 90 red deer on the farm. A number of research laboratories on Roseworthy campus can be used for deer nutrition and biology research, including nutrition, biochemistry, meat science and reproductive physiology. The Animal House can house a large number of deer individually or in groups for detailed research. Current research projects include:

- overcoming summer / autumn nutritional constraints to deer production in South Australia;
- defining protein and energy requirements of fallow deer under a Mediterranean environment; and
- determining salt tolerance of red and fallow deer.

*Deer research at The University of Queensland*
The Darbalara Deer Unit at Gatton Campus, The University of Queensland has recently been wound down with only a few deer being held on Campus . Prior to contraction of the infrastructure the Campus had an area of 32 ha, subdivided into 10 paddocks. There were about 300 red deer and 300 rusa deer. The Research Unit also had deer metabolism cages and other associated facilities. Research projects that were conducted included:

- development of feeding systems for deer, including artificial rearing methods for rusa deer; forage utilisation by rusa deer and early weaning strategies for rusa and red calves;
- nutrient requirements of rusa deer;
- microbial protein synthesis in rusa stags; and
- venison production from castrated and entire rusa stags.

*Deer research at The University of Western Sydney*

The University of Western Sydney has a deer farm with an area of 30 ha, with an access to a small abattoir. There are 12 individual pens for measuring feed intake. The current research is focusing on:

* nutritional requirements and growth characteristics of pregnant and lactating fallow and red deer;
* slaughter techniques for high venison quality; and
* examining the relationship between condition score and eating quality of venison.

*Deer Research Unit at the University of Sydney, Camden*

Established in 1978, this unit was the focus of some 18 years of intensive research on fallow and chital deer. No research has been conducted now for over five years.

*Market and quality assurance research at The Rural Industry Development Pty Ltd*:

The research by this company focuses on expanding the venison market and the development and adoption of quality assurance systems by the deer industry. The current projects are:

* development of niche European, regional domestic and Japanese markets; and
* quality assurance, strategic alliances and industry development.

**References**


Blaxter, K. L., Kay, R. N. B., Sharman, G. A. M., Cunningham J. M. .M. and Hamilton, W. J. (1974). Farming the red deer. Department of Agriculture and Fisheries for Scotland, Edinburgh, Her Majesty's Stationery Office.

English, A. W. (1984a). Chemical restraint of deer. In "Deer Refresher Course". The Post-graduate Committee in Veterinary Science, The University of Sydney. pp. 325-351.

English, A. W. (1984b). Veterinary aspects of deer farming in New South Wales. In "Deer Refresher Course". The Post-graduate Committee in Veterinary Science, The University of Sydney. pp. 325-351.

English, A.W. (1988). Diseases of Deer. Vade Mecum Series A, Number 11, Post-graduate Foundation in Veterinary Science, University of Sydney.

English, A.W. (1992). Diagnosis of Diseases of Deer. Vade Mecum Series B, Number 16, Post-graduate Foundation in Veterinary Science, University of Sydney.

Fox, B. R. (1996). Deer farmers are reaching out and establishing viable, alternative agriculture. *Agri Alternative* In: http://www.agrialt.com/janfeb96/deer.html

Haigh, J.C and Hudson, R.J. (1993). Farming Wapiti and Red Deer. Mosby-Year Book, Inc. St. Louis.

Hanlon, A. J., Rhind, S. M., Reid, H. W., Burrells, C. and Lawrence, A. B. (1997). Effects of isolation on the behaviour, live-weight gain, adrenal capacity and immune responses of weaned red deer hind calves. *Animal Science* **64**, 541-546.

Hudson, R. J. (1999). Wildlife production: trends and issues. In: *Diversified Livestock* http://www.deer.rr.ualberta.ca/library/wcapkorea/WCAPfinal.html

Mackay, B. I. (1985). Report on study tour of New Zealand deer farming industry. NSW Department of Agriculture, Orange Australia.

Mackay, B. (1998). *The new rural industries* (A handbook for Farmers and Investors). Rural Industries Research and Development Corporation. In: http://www.rirdc.gov.au/pub/handbook/deer.html

Standing Committee on Agriculture (SCA), (1979;1980). Deer production in Australia, the outlook for the future. AGPS, Canberra Australia.

Standing Committee on Agriculture (SCA), (1991). The farming deer (Standing Committee on Agriculture, Animal Health Committee). CSIRO Australia.

Smits, J. E. G. and Haigh, J. C. (1990). Specialized livestock – Game farming practice. *In Saskatchewan Agriculture and Food.* In: http://www.agr.gov.sk.ca/livestock/specialized/product_info/Gfpdeer.asp

Spiers, I. and Yerex, D. (1987). Modern deer farm management. Ampers Publishing Associates Ltd., Carterton, New Zealand.

Tuckwell, C. (1998). Management Guide. In *Australian Deer Industry Manual"* No. 7. RIRDC Publication No. 98/58. RIRDC, Canberra.

Wilson, P. R. (1984a). Notes on general anaesthesia of deer. In *Deer Refresher Course*. The Post-graduate Committee in Veterinary Science, The University of Sydney. pp. 392-393.

Wilson, P. R. (1984b). Blood parameters, serology and trace elements in deer. In: *Deer Refresher Course.* The Post-graduate Committee in Veterinary Science, The University of Sydney. pp. 353-366.

Wilson, P. R. (1984c). Diseases relevant to deer farming. In *Deer Refresher Course*. The Post-graduate Committee in Veterinary Science, The University of Sydney. pp. 105-125.