HEALTH

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Introduction

Farmed deer are generally hardy animals that with good management remain healthy and relatively free of disease.

However, deer are susceptible to some diseases that affect other domesticated livestock. Management should consider planned strategic prevention programs and tactical treatment programs for factors that pose a risk to deer health.

The summary of health and disease considerations in this book is by no means exhaustive. The information provided attempts to give an overview of more common health aspects of deer farming in Australia and of management programs that will minimise production losses associated with the conditions described.

Stress is a common precursor to many disease conditions of deer. Deer under stress from cold, parasite burdens, inadequate nutrition etc are at much greater risk from disease-causing agents than other deer.

Management of deer, probably more than most other commercially farmed species, must minimise stress. In particular deer must always have access to shelter (winter and summer) and nutrition and appropriate parasite control programs must be maintained.

Available Veterinary Products

People who use veterinary products on their deer should be aware that there are few preparations currently (December 2002) registered for use with deer.

Deer farmers and veterinarians are not legally prevented from treating deer with products registered for other species. This is commonly called 'off-label use'. However users of such products have no legal claim on manufacturers should problems occur from such off-label use.

Considerations for off-label use should be made with prior veterinary advice and should consider likely beneficial and adverse animal response to chemicals and potential meat residue risks. **THE OFF-LABEL USE OF DRUGS SHOULD BE DOCUMENTED.**

While this manual provides some information about veterinary treatments commonly used by deer farmers it does not recommend off-label use of veterinary products. People should seek veterinary advice before using any veterinary treatments for their deer.

Vaccination

Vaccine costs are minimal, and if only one animal is saved in several years the vaccine cost has been well spent. However, specialist veterinary advice should be sought before the 'off-label use' of any animal health product, including vaccines, in deer.

If animals are to be vaccinated a general recommendation is that they should be vaccinated at weaning and then 6 to 12 weeks later. Ideally animals should be given a 'booster' vaccination annually. Many producers do not routinely vaccinate male animals, but the cost is low so routine annual vaccinations can provide peace of mind.

Bacterial Diseases

Clostridial Disease

Deer appear susceptible to the same clostridial diseases that affect other grazing livestock (see section on bacterial diseases). Although there are few confirmed reports of these diseases in deer in Australia, treatment of affected animals is usually ineffective and affected animals die.

However, currently used vaccines are not labelled for use in deer because they have not been specifically tested in deer species. This means that use of these vaccines in deer must be considered an 'off-label use' as even though experience or anecdotal evidence suggests that they do promote immunity for clostridial diseases of deer, there is no scientific proof that the vaccines work.

The clostridial diseases of concern are: Enterotoxaemia (pulpy kidney); Tetanus; Black disease; Malignant oedema; and Black leg. Although the confirmed incidence of clostridial disease in farmed deer is low, treatment of affected animals is usually ineffective. Animals infected with clostridial disease usually die.

The most commonly seen clostridial disease of deer in Australia is Enterotoxaemia. The disease is most commonly associated with a sudden change from dry feed to lush green feed. Sudden death with rapid carcase putrefaction are the most common symptoms.

A vaccination program is generally recommended for deer. Clostridial vaccines chosen should at least include protection against enterotoxaemia but ideally include all five common clostridial diseases (5 in 1 vaccine).

Salmonellosis

Non-specific salmonella can infect deer and cause symptoms similar to those seen in cattle and sheep.

Infections commonly occur where animals consume water or food that is contaminated with dung, urine, rotting carcases or rotting vegetation. Animals under stress are more susceptible to salmonella bacteria. A veterinarian who can advise on treatment should confirm diagnosis.

Strategic management includes the prevention or routine removal of contaminants from food and water supplies and general hygiene maintenance. Transport management should aim to minimise stress associated with transport, in particular ensure animals are not overcrowded during transport.

SALMONELLOSIS IS TRANSMISSIBLE TO HUMANS.

Tuberculosis (TB)

Tuberculosis is an infective and contagious disease of animals and humans. Affected animals can pass their infection (Mycobacterium bovis) to humans. Australia is currently (December 2002) completing documentation that will confirm its 'Tuberculosis free' status.

All livestock processed in Australia are monitored to confirm the absence of TB and other diseases in Australian livestock and provide consumer confidence in the health status of its products.

Tuberculosis is a major problem in the New Zealand deer herd with possums acting as a reservoir of infection.

Leptospirosis

This disease, caused by one or more strains of Leptospira bacteria (*Leptospira sp*), can be transmitted between livestock, including deer, and can be transmitted to humans.

The disease is reported in deer in New Zealand [48], and its incidence is said to be increasing [78]. Animals severely affected by Leptospirosis usually die while mildly affected animals may only suffer a fever and loss of appetite.

A confirmation of the disease requires a post mortem veterinary examination and laboratory culture of specimens. However, Hutching [48] reports that clinical signs at post mortem include enlarged kidneys enlarged liver, red urine in the bladder and a generalised pale, jaundiced carcase.

The disease is transmissible to humans so care and good hygiene must be the prime consideration before, during and after handling carcases. A veterinarian can recommend treatment regimes that may include identification of carrier animals.

Vaccines for leptospirosis are available for cattle but should only be considered for deer after consultation with a veterinarian. Vaccination programs may be appropriate in endemic areas but should only be considered in consultation with a veterinarian.

Yersinosis

This disease is predominantly a disease of juvenile deer that in severe outbreaks may kill up to 40% of the animals in a herd [48].

It is estimated that about 1.0% of weaner deer in New Zealand die annually from this disease. While Yersinosis affects deer in Australia it appears to occur less frequently than in New Zealand. The bacteria that cause the disease (*Yersinia paratuberculosis*) survive best in cold wet conditions. Deer managed in environments that do not continually provide these conditions for bacterial survival appear less exposed to this disease risk.

Like Salmonella infections, animals are infected when they consume feed or water contaminated with bacteria deposited in animal faeces. Risks increase as stocking density (number of animals per unit area) increases and the likelihood of consumption of grass contaminated by faeces increases. Animals that survive sub-clinical or clinical infections in their first year develop immune responses to subsequent infection challenges.

Through colostrum, breeding females pass passive immunity to their offspring that lasts for three to four months [48]. Common symptoms of the disease are a rapid onset of a watery green scour followed by death in a couple of days.

Treatment includes antibiotic therapy, fluid replacement and management to minimise stress (warmth and good nutrition) for clinically affected individuals and may include a preventative antibiotic for other animals in the mob. A Yersinia vaccine for deer is commercially available in New Zealand. It is not currently available in Australia.

Yersinia, like salmonella and leptospirosis, is transmissible to humans. Hygiene following animal handling and before eating or smoking is essential.

Johne's Disease (JD)

Johne's disease is caused by an infection of an animal's intestinal wall with specific bacteria (*Mycobacterium paratuberculosis*). The bacteria are related to those that cause tuberculosis and are slow growing. Although sheep and cattle are affected by host specific strains of bacteria, deer can be infected by both ovine (sheep) and bovine (cattle) strains.

Unlike the disease in sheep and cattle where it is a chronic wasting disease that develops slowly and symptoms may not become obvious until years after initial infection. JD in deer can cause significant losses in young animals after rapid weight loss with diarrhoea.

Although infected animals may not show clinical signs of the infection until well after initial infection, infective bacteria are continually excreted onto pastures. Bacteria can survive on pastures for about one year [16] from where they are capable of infecting other stock.

A persistent scour is a common symptom although production losses can include reduced milk production and life expectancy. The 'wasting' aspect of the disease results from the animal's reduced ability to absorb nutrients through the intestinal wall, and a chronic scour.

Accurate diagnosis is difficult with INDIVIDUAL live animals although culture of specimens from DEAD animals can confirm the presence of the disease. Diagnosis is based on herd history and laboratory tests including pooled faecal culture to assess the level of infection in a herd.

Control of the disease is by slaughter of infected stock and those in contact. Trials to assess the efficacy of a vaccine are soon to be undertaken.

JD has now been detected in deer herds in Victoria, NSW, SA and Queensland-all bovine strain JD. Because of the way in which herds in Australia were developed, with introductions from many sources, it is likely that the disease is widespread. In NZ, over 300 herds are known to be infected. When purchasing deer, farmers should ask for a declaration from the vendor that Johne's disease has not been diagnosed, or suspected, in deer, cattle or sheep on the property of origin.

Necrobacillosis

Bacteria (*Fusobacterium necrophorum*) that are common in the environment and can also cause foot abscess in sheep and foot rot in cattle cause this disease. Necrobacillosis commonly affects young animals and Fallow deer fawns appear particularly susceptible. Clinical symptoms can include ulceration of the

mouth and pharynx, necrosis and inflammation of the foot, 'bottle jaw' combined with depressed appetite and lesions in the rumen. Young deer more commonly show a rapidly developing infection with a high mortality rate, while older deer are more likely to recover after a period of illness.

The organism that is responsible for the disease persists in cool moist environments particularly those contaminated with faeces or other compost material.

Bacteria that cause the disease cannot penetrate intact tissues [28] but usually invade following damage to the skin surface. However where young deer are continually grazing moist pastures the skin of their feet becomes soft and is easily damaged. If bacteria are present in the local environment they can easily invade this tissue.

Mouth lesions are most commonly seen in young deer being fed grain or other supplements on the ground. Young fawns can be directly affected through the naval.

Infection in feet is commonly recognised by associated greenish-yellow pus. Rapid death of apparently healthy fawns is another common symptom. Diagnosis can be confirmed with veterinary and laboratory involvement.

Treatment involves use of antibiotic therapy and commercially available footbath treatments used for sheep. Specific advice should be sought before initiating a treatment regime. Management to reduce the impact and spread of the disease includes reduction in stocking density and not feeding animals on the ground.

A vaccine called VOLAR (r) is used in New Zealand to control the disease. The vaccine is not available in Australia.

Cryptosporidiosis

This disease is caused by a protozoan parasite (*Cryptosporidium*) that can also affect humans. It is a common infectious cause of death in young fawns. Animals most susceptible appear to be young fawns, before weaning and often less than three weeks old [48].

The disease is often although not always characterised by white to yellow diarrhoea. Affected animals dehydrate and lose condition rapidly over 24 hours and they can die if not treated.

Like most diseases in deer, stress in an important predisposition to susceptibility. Often treatment of other interrelated stress factors including inadequate nutrition, internal parasites, cold or very hot weather and

concurrent disease is more important than the treatment of this parasitic infection. Prevention of the disease relates to provision of adequate shelter, nutrition and prevention management of other health risks. Risk of infection is lowered as stocking density decreases.

In acute infections some success has been achieved treating affected animals with a coccidiocide solution (Baycox), but this should only be considered with advice from an animal health specialist. Hygiene is very important when handling scouring fawns as the disease is easily transmissible to humans.

Pasteurellosis

This disease occurs in other grazing livestock and is generally associated with stress from other causes, transport, cold, inadequate nutrition, etc. Affected animals suffer an acute haemorrhagic septicaemia and are commonly found dead although some animals have been found prostrate with mucous discharges from the nose and mouth [28].

Confirmation of diagnosis requires the post mortem examination of dead animals and the laboratory isolation of the bacteria in affected tissues. Recommended treatment relates to close observation of animals at risk and subsequent antibiotic therapy for any stock showing early clinical symptoms. Affected deer should be kept in a warm semi-dark environment.

The disease usually occurs in winter months and weather stress is thought to be a contributing factor. Control and prevention of the disease relates to programs that minimise animals' exposure to stress, especially during cold, wet and windy weather. Antibiotic preparations provided in feed may be of benefit in outbreaks.

Viral Infections

Malignant Catarrhal Fever (MCF)

Sheep are thought to act as reservoirs for the disease in cattle and the disease is thought to be transmitted from sheep to cattle via biting insects.

Deer are susceptible to this virus that causes cattle losses in Australia. Rusa deer appear to be most susceptible and a similar method of transmission is thought to occur from sheep to deer.

The disease is always fatal in deer although the time from initial clinical signs to death can vary from 2 to 3 days in acute infections to 33 days with chronic infections [48]. Affected animals are depressed, have high fever and may show

a bloody scour before death. Chronically affected animals show similar symptoms to cattle that include mucous discharge from nose and mouth. Often the only symptom seen in deer that have died from acute infections is a cloudy appearance of the eye (Keratosis) [40]. Affected deer are commonly blind and this symptom is particularly common in Rusa deer.

Diagnosis can be confirmed by veterinary necropsy and laboratory examination of specimens.

Preventative management should include controlled management of introduced stock and programs to minimise stress (ideal nutrition - especially in late autumn and winter, provision of appropriate shelter during winter and spring, avoid high stocking density, etc). Another suggestion is that sheep should be managed as far away from deer as possible in known risk areas.

External Parasites

Lice

Lice have been reported in deer in Australia [28]. Lice may be either biting or sucking types but symptoms are similar. Main symptoms include rough matted hair or hair loss on the side of the neck.

Infestations are usually more severe in winter when an animal's hair covering is most dense and long. Animals stressed by poor nutrition or other disease factors are more susceptible to infestation.

At present, there are no chemical treatments in Australia registered to treat deer for external parasites. Common preparations registered for use in cattle are used to control lice on deer. However these preparations cannot be recommended for use in deer and any off-label use of products must be at the deer owner's risk. Cydectin is registered for lice control in cattle and may be of use in infestations in deer but only with the advice of a veterinarian.

Ticks

Ticks are blood-sucking parasites common in tropical and sub-tropical regions of Australia. Deer are susceptible to tick infestation. Immature ticks attach themselves to grazing deer and when engorged with blood drops from the animal and lay eggs in the grass.

Affected animals become anaemic and show depressed appetite. Heavy infestations can kill young animals and reduce milk production from females. Holes in the skin created by ticks reduce the value of leather produced by from the skin.

Each tick can remove 1.0ml of blood out of the newborn fawns total blood volume of about 600 ml. Commonly preparations registered for use in cattle are used to control ticks on deer. However these preparations cannot be recommended for use in deer and use of the products must be at the deer owner's risk.

Control programs include pasture management techniques to reduce tick numbers and grazing of infected pastures with stock less susceptible to ticks. Specific local area advice should be sought from Departments of Agriculture and veterinarians.

Ants

Large ants will attack newborn deer, and in particular those of smaller species of deer. Often ant nests are located in shady and sheltered areas of paddocks (under trees, near sheds, etc) that female deer use to shelter their offspring. There are confirmed reports of very young fawns killed by ants while they sheltered out of direct sun light.

Areas developed to provide shelter for newly born deer should be checked for ants close to the end of gestation and ants controlled. If ants cannot be controlled the area should be fenced to restrict access of the young animals until they are ten days to two weeks old.

Internal Parasites

Herd dynamics and grazing patterns of wild deer mean that they are generally not predisposed to pathogenic parasite infestations. This does not mean that deer are resistant to such infestations, more that behavioural evolution has minimised exposure to challenge from high parasite burdens.

Farmed deer that have their movement restricted by farm management usually have continual access to 'better' pasture. However, their restricted access to pastures inside fenced areas means they are exposed to a higher risk of parasite contamination than would be the case if they had the opportunity for unrestricted natural grazing.

Most research work on internal parasites of farmed deer has been undertaken in New Zealand however comparatively little research has been undertaken and there are considerable gaps in the knowledge [12].

Cydectin ® is one of the few veterinary products registered for use in Red deer in Australia.

Lung Worm

Lungworm is recognised as a major parasite of deer, particularly Red deer, in New Zealand. It is also a parasite of concern in Australia, especially in cold, wet environments.

Animals are infected when infective larval worms are swallowed with food. The larval worms migrate to the lungs, via the blood stream, and mature. Adult worms produce eggs that hatch into immature larvae that are swallowed during coughing and are passed to pasture with the faeces.

Clinical signs are similar to those from other forms of parasitism and include weight loss, rough coat, loss of appetite and lack of exercise tolerance. Animals may cough and show breathing difficulty but these signs are not as common as in cattle infected with lungworm.

Diagnosis can be made on post mortem of infected animals. Faecal egg counts and faecal larval counts can aid diagnosis. Veterinarians can provide confirmation of diagnosis.

In environments where lungworms persist, deer of all ages can carry infestations although infestations are generally only severe in young stock. Animals develop a natural resistance to lungworm as they age although Wapiti/Elk develop resistance more slowly than Fallow or Red deer so the parasite status of Wapiti/Elk should be monitored for longer and appropriate treatments given when necessary [55].

Treatment is effective in reducing infestations within an animal. Because there are no products registered in Australia for treatment of lungworm in deer, none can be recommended. Although some farmers use Ivermectin to treat acute cases this is an off label use of Ivermectin and so should only be considered with the advice of a registered veterinarian.

Benzimidazole formulations of Albendazole (Albendazole C and Valbazen), Fenbendazole (Axilur and Panacur) and Oxfendazole (Bomatak-C, Oxfen, Spectre and Systamex Low Dose) are registered for use in deer in New Zealand. However, Charleston [12] suggests that Albendazloe formulations should not be relied on for lungworm control.

Cydectin ® is registered for the control of lungworm in Red deer.

Gastrointestinal Roundworms

Although it is generally accepted that adult red and Fallow deer are relatively resistant to Ostertagia type roundworms, Wapiti/Elk and their hybrids are susceptible.

Like most gastrointestinal worms, Ostertagia require warm moist conditions for their development on the pasture and animals managed at heavy stocking rates or stressed from poor nutrition or overcrowding will be more susceptible to parasitism.

A strategic drenching program that involves tactical drenching sub plans should be developed for each individual property (see below).

Fading Elk Syndrome

The disease is characterised by chronic (persistent) weight loss that may or may not be associated with scouring (diarrhoea). Research in New Zealand has shown that round worms in the abomasum (4th compartment of the 'ruminant stomach') were involved with the disease.

It is generally thought that Wapiti/Elk are more susceptible to this disease because they evolved in areas of North America where the disease parasites were not present [55].

Fading Elk syndrome should not be confused with chronic wasting disease, a serious disease of deer and Elk in Canada and the USA, caused by a prion, (infectious protein) and related to BSE in cattle. This disease has not been diagnosed in Australia or New Zealand.

Management

Management programs suggested [55] to reduce the risk of exposure to fading Elk syndrome include:

- Grazing Red deer and Wapiti/Elk on separate pastures
  - Aim to prevent parasite contamination of Wapiti/Elk pastures by Red deer
- Aim to graze Wapiti/Elk on longer pastures
  - As parasite larvae tend to survive best in the bottom 5 cm of pasture and Wapiti/Elk eat from the top down longer pastures reduce intake of parasite larvae
- Develop a tactical drenching program specifically for the property (see below)
  - Aim to prevent build up of parasite burdens on pasture and in animals

Treatment

The most effective treatment for fading Elk syndrome is the drug is Moxidectin (Cydectin ® is registered in Australia) applied at the recommended rate or Ivermectin, subject to veterinary advice, at twice the recommended rate [56].

Monitoring

As the parasites responsible for this syndrome cause most damage as larval parasites (too young to lay eggs) monitoring of faecal egg counts is of no benefit in monitoring the problem in deer.

If animals show unexplained weight (not seasonal) loss fading Elk syndrome should be quickly eliminated as a cause of the loss by treating them as soon as possible as indicated above. Affected animals may take weeks to recover from severe infections.

Strategic Internal Parasite Control

Control of internal parasites on a farm should be well planned and integrated to consider aspects of animal and pasture management.

It is generally accepted that at any one time the proportion of a grazing property's parasite burden that is present in animals on the property may be less than 20% and the proportion that is in pastures may be more than 80%.

Planned control programs aim to minimise pasture contamination by stock and reduce the ability of infective parasites to survive on the pasture. A goal of eradication is considered impossible and parasite-free pastures rarely exist.

Introduced Stock

Stock introduced to a property should be held in isolation from other stock for six to twelve weeks (the longer the better) in a quarantine area on the property.

During this time animals can be treated for parasites and monitored for any health risks that they may introduce to existing stock. Ideally introduced animals should be exposed to several of the owners stock in the quarantine area before exposure to general herd populations. The exposed animals are monitored for health problems during the quarantine period.

Apparently healthy animals can carry disease that they have immunity to or to which they haven't yet developed symptoms.

Grazing Management

Most animal parasites are host specific (they only infect a particular species) although some cross infestation can occur.

This general host specificity can be used as a tool to reduce pasture contamination. If cattle graze pastures after deer have finished grazing, many of the deer-host specific parasites can be destroyed.

Pastures that have not been grazed for six to eight weeks usually have fewer parasites per kg of dry matter. The reduction in parasite concentration is often just a function of an increase in pasture dry matter while parasite numbers stay approximately constant.

Young animals (most susceptible to parasite infestations) should be given first access to 'fresh' pasture to minimise their exposure to infective parasites present in the pasture. As deer preferentially graze the tips of plants, those grazing a paddock first are at significantly less risk of parasitic infection than those that graze the shorter pasture.

Priority for pastures should begin with weaners and end with mature males.

Paddocks that are cut for silage and hay should be rotated. Cutting and removal of silage or hay from a paddock can reduce parasite burdens in a paddock. The reduction can be maximised if the paddock is spelled for an extended period after cutting especially in hot dry weather.

Strategic Drenching

Strategic drenching involves the planned use of drenches (anthelminitics) in association with animal and pasture management programs that will most effectively reduce losses from internal parasites.

Timing for strategic drenching takes into account the parasite to be controlled, age of stock, production status of stock (susceptibility), grazing management program and drenches available.

Programs will vary widely depending on species of deer, parasite risk, grazing management and local environment. Often the most effective drench treatments are undertaken when the animals are apparently at least risk of infection (mid summer).

Special consideration needs to be given to animals grazing irrigated pastures in summer.

Tactical Drenching

Tactical drenching is the tactical use of an unplanned drench treatment(s) in the event of unexpected increase in a parasite burden.

If, for example, unexpected summer rain caused a dangerous increase in lungworm parasitism an unplanned tactical drench may be required to control the parasite and minimise production losses.

Parasite Monitoring

Property parasite burdens can be monitored to assist the development of a strategic drenching program and to determine any need for a tactical drenching treatment.

One method of monitoring animal parasite burdens is to watch animals for the first sign of symptoms. This watch and see method will certainly identify a problem but not before animals are experiencing depressed growth rates, milk production, etc. Affected animals do not recover their health immediately after drenching so production losses can be significant.

More positive methods of monitoring include use of faecal egg counts (FEC), faecal larvae counts (FLC). These options provide low cost methods of assessing parasite burdens within animals and on pasture. They should be undertaken at regular intervals (6 to 8 weeks) and used to develop treatment programs. Interpretation of information should be undertaken with help from a veterinarian or animal production specialist. The tests have some limitations including their inability to monitor male and immature worms (they do not lay eggs).

Most concern rests with their inability to detect immature worms that are the most pathogenic (disease causing) stage of a worm's life cycle. Monitoring of larvae on pasture is used in some areas to better assess the safety of pastures, particularly for weaner stock.

Elk Fading Syndrome

Note the limitations on monitoring parasites that contribute to this syndrome that are described above.

Drench Resistance

Inappropriate use and over use of drench chemicals can encourage internal parasites to develop mechanisms that make them resistant to treatment chemicals.

Drench resistance is a significant and increasing problem for sheep and cattle owners in many areas of Australia. The effects of drench resistance include:

- A decrease in the effectiveness of the drench
- An inability to economically control internal parasites on a farm
- An increased susceptibility of stock to other animal health problems
- Depressed production ability of animals
- Profit reduction.

Australia, New Zealand and South Africa have among the highest levels of drench resistance in the world. The two most common contributors to the development of drench resistance are under dosing animals and dosing too frequently.

Under Dosing

To avoid under dosing it is important that each animal be dosed according to directions supplied with the drench product. Most importantly, drench requirements are usually related to body weight so an animal's weight must be known to enable a correct calculation of the dose required for the individual.

Available information does indicate variability between individual animals, subspecies and species in their ability to metabolise (breakdown) anthelmintics [12] so treatments must ensure that animals are treated with appropriate dose rates (in particular avoid under dosing) to ensure effective treatment.

Where large numbers of animals are to be treated, a practical way of ensuring that all animals receive an adequate dose without weighing each animal is necessary. Two or three of the heaviest animals in a mob are weighed and then the dose rate for the whole mob is set according to the requirement of the heaviest animals in the mob.

Although some smaller animals may receive a dose slightly above their body weight requirement, this method ensures that all animals receive at least their minimum dose. Do not dose according to the average weight of animals in the mob. This practice means at least half the animals will be under dosed!

There is no benefit in generally increasing the dose rate above that recommended by the manufacturer. A higher than recommended dose will not be more effective, but it will cost more.

Dosing Too Often

No drench is 100% effective although many are very close (more than 99%) when used according to directions and where resistance is not considered a problem.

There are always some individuals in a population that are inherently more resistant to chemical treatments. When drenches are used correctly the percentage of these individuals in a population remains stable or increases only slowly.

Where populations are exposed to sub-lethal doses of chemical or are too regularly exposed to a chemical, the percentage of the resistant individuals in a population increases. Eventually the resistant individuals become the dominant percentage in the population. This new population is resistant to the drench chemical.

Resistance can be developed to a range of chemicals successively or at the same time if they are all used inappropriately. To avoid dangers created by over use of drench chemicals, drenching programs should be planned and integrated with animal and pasture management.

Drench chemicals should be rotated at strategic intervals (one or two years) and with advice from an animal consultant or veterinarian. **[It is important that rotations move between drench groups not just between brand names]**.

Some owners use Ivermectin chemicals in the belief that resistance is not a problem with this group of chemicals. However resistance by a cattle parasite in New Zealand has been confirmed [90].

Generally farmed deer in Australia harbour few parasites. With carefully planned integrated management programs the life of all drench chemicals for deer can be extended. A planned program should include a long-term rotation with all available chemicals including those in the Ivermectin group.

Metabolic Diseases

Metabolic diseases are diseases that are related to the feed and water consumed by an animal.

Facial eczema is a disease caused by a toxin contained in spores of a fungus that grows in pasture during warm moist conditions. The disease occasionally causes a problem in sheep and cattle in Australia, but the incidence of the disease in deer in Australia is generally low.

Ryegrass Staggers

Ryegrass staggers is well known in Australia and Perennial Ryegrass staggers is reported from New Zealand. The diseases are similar.

This disease affects all deer species, but is more common in Wapiti [49]. Sheep, cattle and goats are also acutely susceptible to this disease that occurs on some ryegrass pastures.

Ryegrass staggers is caused by a toxin produced by a fungus growing in and on ryegrass plants, usually through the spring and autumn during periods of high temperature and humidity.

Affected animals show muscular tremors in the neck, back and shoulders. Stressed animals often show a jerky stair-climbing gait and may fall when attempting to walk.

Severely affected animals often die although effects of poisoning can abate if animals are removed from contaminated pasture. Affected animals should be kept unstressed with easy access to good quality hay. Consideration should be given to removing ryegrass from affected paddocks.

Trace Elements

General

Compared to research undertaken on trace element requirements for sheep and cattle, little has been reported for deer. With the exception of copper requirements, most researchers suggest that, requirements of deer for trace elements are similar to those for other domestic stock. Estimates of daily mineral requirements for deer provided in Table 34 are adapted from [38].

Major Elements (% dry matter)	
Sodium Chloride	0.18
Calcium	0.50
Phosphorus	0.30
Magnesium	0.15
Potassium	0.65
Trace Elements (ppm)	
Sulphur	0.15
Iodine	0.50
Iron	50.00
Molybdenum	0.30
Copper	15.00
Selenium	0.30
Zinc	35.00
Manganese	35.00
Cobalt	0.15

Table 34: Estimates of daily mineral requirements for deer

Australia has many areas that are deficient in trace elements and animals grazing those areas are routinely provided with trace element supplements in a range of forms. Deer are likely to require similar supplementation. Deficiency problems seen in Australia and New Zealand include those related to inadequate intake of copper, selenium and cobalt. Trace element deficiencies are most likely when pasture is growing rapidly (spring/autumn).

Often plants have very small requirements for trace elements so their growth may be unaffected by low soil availability. When plants grow slowly their rate of uptake of trace elements may provide stocks with adequate intakes (concentration of trace elements per kg of pasture dry matter). The other common time for deficiencies to be obvious is when pasture is very short. This means that animals are unable to consume enough of the pasture to source their trace element needs.

Monitoring

Farm monitoring to assess trace element status has three parts: animal monitoring, pasture monitoring, and soil monitoring.

Monitoring should begin with animal monitoring that assesses the trace element status of a range of classes of stock. Those most at risk from deficiencies are young stock and pregnant or lactating females. Monitoring of animals should be undertaken at least four times per year (mid summer, mid autumn, mid winter and mid spring), when the greatest risk of deficiency exists. Liver from slaughter deer can also be examined.

Pasture samples can be routinely collected at the time of animal sampling or can be collected later if animal monitoring shows deficiencies. Pasture assessments can be matched to animal assessments to determine whether any animal deficiencies are reflected in pasture deficiency.

If pasture deficiencies are detected soil assessments should be undertaken to determine whether soil applications, pasture applications or animal treatments are the most efficient and cost effective method of combating deficiency problems. Specialist advice is needed.

Deficiencies may only exist in some areas of a property in some years or may require blanket treatment of all stock several times a year.

Copper

Most reports suggest that, relative to other domestic livestock, deer have a high requirement for copper and appear to have a greater tolerance of high copper levels. Anecdotal evidence suggests that while this is true for Red deer and Wapiti, it is not as evident with Fallow deer.

Research in New Zealand suggests that deer have a limited ability to absorb mineralised copper from the digestive tract and either do not have the ability to retain copper or they rapidly excrete it from the liver [48].

Deficiency symptoms include those commonly seen with sheep and cattle:

- Sway back (enzootic ataxia) - affected animals become uncoordinated especially in the hind legs, in severe cases animals may be unable to stand on their hind legs - most common in young animals
- Rough (steely) coat
- Joint abnormalities
- General ill thrift
- Increased susceptibility to other health problems

Velvet producers report significant reduction in velvet yields when dietary copper intake is below that required. Programs to treat deficiencies should include examinations of soil and pasture trace element status. Correction of deficiencies may include soil/pasture treatments or may just require routine animal dosing.

An estimate of the copper status of a herd can be obtained by blood testing ten deer. If three or more of those animals have serum copper levels of less than 8 umol/litre it is likely the herd is copper deficient. Like New Zealand deer farmers many Australian Red deer and Wapiti farms routinely dose deer with commercially available copper capsules, however most are not registered for use with deer so veterinary advice should be sought before their use. If deer that are not copper deficient are treated then copper toxicity may occur.

An alternative to copper capsules (copper bullets or boluses) for the treatment of copper deficiency is copper injections. Injections may be cheaper but also potentially more dangerous. Only consider using copper injection with the advice of a veterinarian.

Selenium

Selenium is the central element of Vitamin E molecules. White muscle disease may result from a deficiency of selenium, vitamin E or both.

Although little is known of selenium deficiency effects in deer, deficiency has been reported in New Zealand [28]. Deficiency symptoms for other grazing livestock include lack of exercise tolerance, ill thrift, sudden death after exercise, muscular stiffness, and trembling of the limbs.

Blood samples from a sample group of animals to assess blood glutathione peroxidase (GSHPx) levels can give an idea of the selenium status of a herd. Blood levels of less than 50 u/ghb gshpx indicates marginal selenium uptake in most ruminant species.

Many soils in Australia are thought to be deficient in selenium and that low selenium levels can result in a sub-clinical effect with reduced herd production efficiency seen in lowered growth and reproductive rates. Animals with white muscle disease result from severe selenium deficiency.

Common post mortem findings include white streaking in muscle (white muscle disease) particularly heart muscle. Deficiency may be confirmed by blood analysis and advice on supplementation should be sought from a veterinarian. Treatment may include selenium supplementation, vitamin E supplementation or both.

However care must be taken with oral dosing as excessive selenium intakes can be lethal.

A control program may include soil supplementation using pasture topdressing with prilled selenium pellets.

Cobalt

Cobalt is the central element of the vitamin B12 molecule.

Symptoms of cobalt deficiency are thought to be similar to those demonstrated by other livestock species. They include ill thrift and poor growth rates. Measurement of blood vitamin B12 levels is used to make assessment of cobalt status of an animal.

Treatment of acutely deficient animals with vitamin B12 injections usually provides dramatic results, however long term treatments may involve animal or pasture cobalt supplementation.

Summary

General Comments

- Deer are generally hardy and tend to show a greater resistance to parasites and disease than other farm livestock
- Avoidance of stress, including climatic, nutritional and physical stress is the key to maintaining healthy deer
- Provision of adequate nutritional management, shade and shelter in both summer and winter can be of assistance in minimising climatic stress
- Ideally all deer should be vaccinated with 5 in 1 vaccine to assist in the prevention of clostridial diseases, although most farmers of in Australia don't vaccinate their stock. This involves two injections 4 to 6 weeks apart at weaning followed by an annual booster injection - **careful consideration of 'off-label use' (see above) must be made**
- Seek veterinary advice on monitoring blood levels of trace elements if deficiencies are suspected
- Internal parasites can be detected by monitoring faecal egg counts and this should be carried out prior to commencement of any drenching program. External parasites such as cattle tick and bush tick can also be a problem in some areas. Treatment programs for ticks include chemical applications and advice on the best control program should be sought from the local private or government veterinarian
- Any drenching programs should be strategically focussed and faecal worm egg counts obtained prior to recommendations. Drenching of primarily young stock at weaning is practiced as a precautionary measure

Red Deer

- Red deer are susceptible to Malignant Catarrhal Fever (MCF) and can become infected through contact with sheep but incidence of this disease in Australia is low
- Red deer are reported to have higher requirement for copper than other livestock. Most Australian Red deer farmers routinely dose their stock with copper to maximise velvet production and monitoring good health. Veterinary advice should be sought before treating stock
- ***Most adult mortalities appear to result from misadventure rather than disease***

Fallow Deer

- Monitoring of faecal egg counts should occur to provide warning of build-up of internal parasites that can be especially damaging to undernourished weaners
- Other potential problems are pasteurellosis and necrobacillosis, although fallow deer appear to be less susceptible to problems that have been seen in other species, such as malignant catarrhal fever (MCF), yersiniosis and lungworm

Wapiti/Elk

- Wapiti are reported to have higher requirement for copper than other livestock. Most Australian Wapiti farmers routinely dose their stock with copper to maximise velvet production and monitoring good health. Veterinary advice should be sought before treating stock
- The Wapiti/Elk fading syndrome, common in Wapiti in NZ, has not caused any problems in Australia to date. This may be in part due to the naturally higher percentage of fibre in Australian grazing diets than NZ diets

Rusa Deer

- Mortality rates recorded in Queensland for animals older than 6 months (ie. post-weaning) have been around 2% for females and 4% for males, although breeding males can have mortality rates approaching 10%
- Most adult mortalities have been assumed to be associated mainly with stress-related incidences including environmental (exposure), nutritional and handling (trauma) stress. Predation is also a factor on some properties.
- Routine vaccination with clostridial (5 in 1) vaccines is recommended and Leptospiral vaccination programs have also been suggested as a preventative measure on some properties where the disease is potentially present (eg. cattle and deer properties)
- Rusa deer, as a tropically adapted species, are tolerant to cattle tick exposure with associated degree of resistance, however they are susceptible to the effects of the paralysis tick with infestations on juvenile stock being potentially fatal
- Rusa deer are also particularly susceptible to Malignant Catarrhal Fever (MCF) arising from contact with sheep (carriers of the virus) and high death rates can occur. Farming in conjunction with sheep or adjacent to sheep properties should be avoided