Herd Management of Farmed Red Deer

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Abstract

Satisfactory production from intensively farmed deer requires that their highly sensitive nature and social behaviour be considered in farm management systems and procedures. Confinement obviously modifies behaviour ascribed to wild red deer (*Cervus elaphus*) and this is discussed in terms of movement, fences, harassment, and separation. Basic requirements for farm layout, including fencing, laneway systems, and yards are outlined and handling methods described. Nutritional requirements of red deer in relation to season, age and sex are discussed.

Mating strategies are discussed in terms of stag/hind relationships, harem formation, and stag mating ability. Mating management recommendations are made and a schedule for single-sire mating and calving of red deer included. Behaviour of calving hinds and newborn calves is reviewed and management practices recommended based on the tameness of the hinds and the need to minimise disturbance and interference of less tame hinds over calving.

Seasonal management of young stags, velvetting stags, and breeding stags is outlined. This includes removal of antlers in velvet for safety reasons as well as for velvet antler for sale; a removal method is described. Management for venison production and disease prevention are briefly reviewed.

Keywords: Cervus elaphus, Dama dama, *deer, farming, management*

Introduction

The development of deer farming in New Zealand has a short but dynamic history. Before 1969 the farming of deer was not permitted by law under the Noxious Animals Act (1956). In 1969 deer farming was legalised with the passing of the Noxious Animals in Captivity Regulations and the Deer Farming Regulations. Now 14 years later there are approximately 280 000 (September 1984 estimate) deer on over 2000 farms in New Zealand. These animals are predominantly red deer (*Cervus elaphus*, 84%), fallow deer (*Dama dama*, 14%) and wapiti-type and wapiti × red hybrids (1.7%). About 85% of all deer farms are units which have been established within farms carrying traditional farm livestock (Gladden 1982). A national survey of deer farms in 1981 showed that most deer units are on arable land which has alternative uses for intensive farm production.

The earliest deer farms were generally established by people associated with the recovery of wild shot venison who foresaw that the wholesale shooting of wild deer from helicopters and the ground would not result in sustained yields of venison for export. Amongst the early deer "farmers" were some who fenced in deer living on their farmland to ensure a renewable source of venison and to protect the deer on their properties from poaching or shifting. More recently the supply of live deer has come largely from trapping in pens and from helicopter capture using net guns or darts containing tranquilliser; these have now been fitted with radio transmitters for tracking, obviating the need to pursue darted deer in a helicopter to keep them in sight (Wallis and Hunn 1982). Postcapture losses have varied but have been reduced by adopting such capture techniques which are less stressful on the deer. Deer farming could not have expanded rapidly without the substantial input of animals captured in the rugged mountain country using helicopter transport.

Initial efforts to farm deer usually involved minimal management, with deer run in 1 mob on ring-fenced hill paddocks with bush. However, soon innovative farmers on flatter, more productive country became interested in farming deer under more conventional farming systems. Wild captured red deer have adapted well to pastoral systems used to farm sheep and cattle and characterised by large herds of animals rotationally grazing improved grass – clover pastures at high stocking densities. It is fortuitous that this species, the most populous in the wild, has proved the easiest to farm successfully.

Wapiti (*Cervus elaphus nelsoni*) or wapiti-type deer captured from Fiordland generally have not

adapted to a high-quality pasture diet as well as red deer. Some cases of nutritional scouring have occurred, but this problem appears to have been overcome mainly by supplying more fibre in the diet, usually in the form of lucerne hay. Many of the fallow deer on deer farms were either fenced in, trapped in, or captured nearby and so were not subjected to a considerable change in diet. However, handling facilities appropriate to the more flighty disposition of this smaller deer have taken longer to develop.

Some aspects of farm management have had to be adapted and changed to accommodate the peculiar biology and temperament of each species or type of deer compared with conventional farm animals, e.g. high fences, high close-boarded yard walls, and enclosed transport crates are necessary to counteract the jumping ability of deer. New management practices have been developed chiefly in the handling of deer, with new fence and yard designs and handling techniques including the use of body crushes. There have also been significant developments in management at mating and calving and in animal health procedures (Yerex 1982). This paper reviews these aspects of farm management in some detail after discussing the implications of confinement for farmed deer. Most comment relates to red deer, but fallow and wapiti-type deer are also mentioned. Much of the observation was made at Invermay, a Ministry of Agriculture and Fisheries research centre, near Mosgiel in Otago Province. The deer unit at Invermay covers 74 ha with over 600 deer. Details of the unit are given in Appendix 2.

When considering the effects of management, it must be remembered that deer farming is an economic undertaking. Management does not aim to duplicate conditions available to wild deer nor to provide for trophy hunting. It is designed for economically efficient production of deer for venison and velvet antler and live deer for sale. By-products from deer, such as deerskins for quality leather, upper canine teeth for jewellery, tails, sinews, and pizzles for the South-east Asian medicinal market, also have considerable value.

Satisfactory production from intensively farmed deer requires that their highly sensitive nature and social behaviour be considered in farm management systems and procedures. Substantial wastage in production can occur through neglect of factors causing stress or death by misadventure in farmed deer.

Confinement

Movement and fences

Confinement within a restricted area will obviously modify the diurnal and seasonal movement ascribed to groups of wild red deer. Fraser Darling (1937) observed that on hill land in Scotland red deer are found at higher altitudes during the day and come down to feed on grassland at lower elevation in the evening. This daily movement is reversed in farmed deer at Glensaugh (Blaxter *et al* 1974), indicating that such movement is a response to environmental conditions rather than an instinctive drive which would be liable to frustration in confinement.

The urge to move freely remains strong however, as shown by the marked propensity for fence pacing by deer farmed in Scotland, New Zealand, and elsewhere, causing erosion to fencelines and undue expenditure of energy. This fence pacing occurs more commonly with recently captured deer, stags before and during the rut, hinds before calving, and newly weaned calves. Fence pacing also occurs with newborn calves seeking their dam, deer attempting to join others in adjacent paddocks, or in attempts to obtain shelter, feed, or water.

Well developed flight responses and the deer's ability to leap mean that a 2 m high perimeter fence is necessary to confine deer on a farm. Poor visibility of wire netting on fences can result in fleeing deer coming into damaging contact, and in moving or yarding deer, their nervous flight responses have to be taken into account. Rails on wire fences, scrim, or manuka scrub (*Leptospermum* spp.) are commonly used as a visual barrier in conjunction with netting fences to facilitate moving the animals particularly for yarding. A quiet but firm approach and patience are required in yarding deer; unfamiliar objects or movements in their path will cause them to balk and panic.

Harassment

Instances of harassment have commonly been observed within groups of red deer at Invermay. Stags or hinds may bite one another or flail with their forefeet. In stag herds during the breeding season a small animal may be repeatedly chased and mounted as in large all-male mobs of other farm animals (Kiley-Worthington 1977). Among hinds 1 may be repeatedly chased and backbitten, and in confined conditions with little cover hinds may beat others' calves (Kelly and Drew 1976). These victimised deer may be injured or unhealthy and become more debilitated by victimisation. Such deer pose a dilemma for the farmer because of their strong herding instinct; in paddocks on their own they attempt to rejoin adjacent mobs, and if held in yards to recuperate, on rejoining the herd they are liable to suffer further persecution. Chances of harassment resuming may be reduced by reuniting 1 or a few deer with a herd in the yards

rather than in a paddock. Returning the herd to a different paddock may also reduce further victimisation, if the deer are hungry and good feed is offering. This technique may be used when a small number of deer are brought onto the farm to be run with an established group.

Separation

Age and sex classes often need to be treated differently, so farmers commonly segregate them into separate mobs. For convenience and efficient use of feed and labour resources, calves are often weaned at 3 months of age and reared in single-sex groups. Mature hinds are kept apart from stags except for mating, and the stags are likely to be divided into a number of groups depending on age and the stage of velvet antler development. The patterns of forced association and segregation are quite different from those found in wild populations but in general have not caused major problems within farming systems.

When mating groups are adjacent to one another in small paddocks (1 – 2 ha) the breeding stags can cause considerable fence damage fighting through the netting. Fences need to be well maintained to separate breeding stags in small paddocks and it is preferable to have the mating groups at least 1 paddock apart to avoid fence damage, or mating paddocks should be contiguous only at 1 corner. In small paddocks (< 1 ha) only single-sire mating is possible unless yearling stags are used, as otherwise the dominant stag will sometimes literally hound subordinate stags to death within the small confines.

Over the rut, herds of non-breeding stags used for velvet antler production should be managed in a way that reduces energy loss through undue fence pacing and minimises fighting with its associated damage to pasture and fences. No detailed research has been undertaken on this topic. From observation and a general understanding of stag behaviour it is suggested that herds of non-breeding stags aged over 3 years should be run in a separate unit or paddock(s) distant from mating groups of deer. Herd size and stocking density should be reduced to the lowest possible level within the limits of management of the farm, to allow the maximum amount of space per animal.

Overall the advantages of separating intensively farmed deer by fences into different age/sex class groups are numerous. They include the ability to single-sire mate for genetic gains in desired production characters and to feed different classes of deer the quality and quantity of feed appropriate to the productive response required for good overall management. With separation of deer into different age/sex classes, operations such as removal of velvet antler from stags or anthelmintic treatment of young deer can be undertaken with minimal labour and without unnecessarily disturbing animals which do not require treatment—a blatant example of unnecessary disturbance would be the yarding of an unseparated group of stags and hinds during calving to remove velvet antler from the stags.

Fences, Layout, Handling, and Yards

Fences and farm layout

Perimeter fences on New Zealand deer farms are usually 2 m high, made of 13 wire high-tensile netting with 150 or 300 mm wide gaps. Tanalised radiata pine posts are spaced about 5 m apart to comply with regulations. Present costs for materials and erection are about NZ$6 – 7/m. These perimeter fences are not as sophisticated as types found on deer farms in Australia or West Germany where deer need to be protected from predators. A netting mesh finer than the standard 150 mm stay is required for fallow deer, as on some farms up to 25% of young fawns have been lost with their legs hooked over wires in this standard 150 mm stay netting (Moore and Brown 1979).

Within the farm perimeter fence cheaper subdivision fences are used, but 2 m high fences are still required to separate stags in different mating groups. For grazing control of young stock after weaning until 15 months of age, 1 m high sheep netting with a top and/or outrigger electric wires have proved adequate. Temporary electric fences which can be erected at a cost of 60 – 70 c/m are widely used for break feeding herds on pasture. One "hot" wire can contain some herds, but when availability of pasture is restricted, 4 electrified wires spaced from 15 cm to 130 cm above the ground are necessary.

The general layout of paddocks depends on the farm topography but needs to be centred on a system for yarding deer. Gateways should be sited so that deer passing through continue straight on and do not turn along the gated fence taking deer left inside with them. Gates offset from paddock corners cause less hesitation in deer moving through. Wing fences towards gateways aid herding from larger paddocks and a flowing system of laneways is an essential feature for control in yarding fractious deer.

Handling and yards

Deer can easily be trained to come to a call using a high-quality supplementary feed and thus can be shifted from paddock to paddock by 1 person without herding. Aids used to yard deer include dogs, horses, motorcycles, other vehicles, and

occasionally helicopters. Horses have proved useful in moving belligerent stags during the rut when motor vehicles are useless and are often damaged by the stags. Scrim or similar material held between people, thus providing a visual barrier, has proved useful in moving less tame or wild captured red deer and the more fractious fallow deer along a laneway for yarding.

A lead-in race which has an indirect approach to the yards allows deer to be moved closer before the yards come into sight, when the animals may hesitate. Opinion varies on the relative merits of lead-in races which are uphill, downhill, undulating or flat. However, uphill races have a disadvantage in that animals which break back can gain speed quickly and the people attempting to yard the deer appear less dominant than they would if yarding were being done downhill.

Yard designs vary but usually have the following features in common:

- indirect approach of the lead-in race to the yards;
- yard walls which are close-boarded or solid (2.25 m high for red deer and wapiti, 2.6 m for fallow deer);
- no sharp corners or projections, to obviate crushing and injury;
- darkened pen for handling, preferably with electric light and a dimmer switch, and
- for adult wapiti, provision to treat animals in a crush or press or from outside a pen.

Mechanical crushes have been developed to assist in restraining deer particularly for disease testing and velvet antler removal and, for fallow deer, for routine drenching, tagging, and vaccination. Such crushes have padded sides; the animal is lifted or the floor dropped away ensuring that the animals is sufficiently immobilised.*

Red deer are easily worked in yards with which they are familiar and by only 1 or 2 people. Young stock, yearlings, and breeding hinds can be handled easily in a pen without the aid of a crush. Larger wapiti × red hybrids and wapiti whose size renders them potentially more dangerous than red deer are best worked from outside a holding race or crush. As wapiti tend to stand their ground when yarded and do not move as freely as red deer, safe movement of these animals is aided by the use of a catwalk above the pens and swinging or sliding gates to move them along.

Fallow deer are much more highly strung and flighty than the larger deer and are easily disturbed. Consequently, slow, quiet, and considered movements by handlers are required to avoid causing the fallow deer to panic thus risking injury to themselves. Fallow can quite easily jump up and scramble over yard walls up to 2.3 m high, and sources of light coming into darkened pens need to be covered, as fallow deer will persist in jumping towards these for escape. For handling large numbers of fallow, a suitable crush is essential (Moore and Brown 1979; G. Asher unpubl.; Yerex 1982).

Nutrition

Nutrition of red deer has been well reviewed by Kay and Staines (1981). The red deer is described as "versatile, equally able to browse woody vegetation or graze grasses and herbs". The extent of browsing or grazing varies according to season and location. Feed requirements for farmed red deer in New Zealand have been detailed by Fennessy *et al* (1981a) and Fennessy (1982). Seasonal feed requirements vary depending mainly on the level of production desired but also on the animals' maintenance requirements. Stags have very high relative requirements over winter because they lack body energy reserves and subcutaneous fat, whereas hinds have relatively high requirements during summer when they are lactating (Fennessy *et al* 1981a).

For a pastoral system of farming to be efficient, the pattern of feed demand should match the pattern of pasture growth. Throughout much of New Zealand growth of improved grass or clover pastures is generally greatest during spring, declines over summer and autumn, and is low during winter (Round-Turner and Scott 1976). Controlled break grazing of hinds in late pregnancy (October) to regulate feed intake as a precaution against dystocia is advisable, particularly when hinds have been mated to large wapiti-type bulls. With red deer hinds that give birth in summer it is important to ensure that pastures remain vegetative to provide high-quality grazing for the lactating hinds. Good lactational feeding for hinds in summer is important, as underfeeding can lead to a marked depression in calf weaning weights. Sheep and cattle are often used to control spring pasture growth on deer farms; surplus spring feed can otherwise be made into silage or hay to conserve for winter feeding when pasture growth is minimal and the maintenance requirements of the deer highest. Cuts of silage taken in late spring allow about 3 weeks of regrowth on paddocks prior to calving; such pasture provides excellent feed for hinds in early lactation. Paddocks cut for silage or hay in late summer and not subsequently grazed provide parasitologically "cleaner" pasture for weaned calves in early autumn thus aiding parasite control.

* Information on these crushes can be obtained through the advertisements in issues of *The Deer Farmer*, P.O. Box 2678, Wellington, New Zealand.

Table 1: Ranges of growth rates recorded in young red deer at Invermay between 1974 and 1981

	Growth rate (g/day)		
	Autumn	Winter	Spring/Summer
Males	19 – 159	41 – 122	224 – 256
Females	4 – 186	16 – 63	156 – 214

Nutrition of the young deer, like that of other young farm animals, is very important. For calves weaned pre rut in March, growth rates are mainly dependent on the quality and quantity of feed supplied, but it is important to minimise stress on calves over weaning so that any growth check is minimal. The range of growth rates recorded in calves at Invermay (Table 1) indicates both seasonal and animal variability. Growth potential during autumn and winter is limited, but it increases greatly over spring/summer. While calves should be well fed in winter to ensure survival, feeding supplements at a high level may not be cost effective except for increasing the liveweight of lightweight female calves to ensure that they reach puberty at 16 months of age.

The importance of feeding deer well over winter to avoid mortality from exposure/starvation stress and related diseases has been recognised (McAllum 1980). Deer have been fed successfully on most of the supplements and root crops traditionally fed to sheep and cattle; these include good quality meadow hay, lucerne hay, grass silage, barley, maize, swedes, and dried lucerne – grain-based pelleted rations. Supplementary feed needs to be well dispersed to minimise competition between deer for feed and ensure equal feeding opportunities. This is particularly important in early winter with groups of stags where agonistic behaviour is still common. It is also especially important where animals are being fed grain, in order to minimise the possibility of individuals gorging themselves and suffering from grain poisoning. If adult hinds enter winter in good condition then controlled break grazing can be used to regulate feed intake on autumn-saved pasture and these hinds can safely lose up to 5 kg over winter. However, over periods of adverse weather these hinds should be well fed.

Shelter can reduce the effect of windchill and reduce feed requirements. Wintering deer, particularly stags, in young plantations is not advisable since young trees can be killed by overbrowsing and by stags rubbing the bark with their antler stumps; however, wintering in older plantations is a very useful method of reducing heat loss thus reducing feed requirements.

The use of feeding standards allows feed supplies to be allocated efficiently for the attainment of desired levels of animal performance on farms (Harbord 1982). Nutrition is of considerable importance in relation to reproductive efficiency and is further discussed in the next section.

Mating

Hind nutrition

Through effects on hind liveweight, nutrition influences fertility and calving date. Kelly and Moore (1977) reported that the fertility of hinds that weighed 61 – 65 kg at mating was 50% and at 70 kg fertility was over 90%. Hamilton and Blaxter (1980) reported similar data for red deer in Scotland. Age had no effect over and above that of liveweight, suggesting that the difference in fertility between 2-year-old and older hinds reported by Bray and Kelly (1979) may have been at least partly due to a difference in liveweight.

Hamilton and Blaxter also calculated that for each 1 kg increase in liveweight at mating, calving occurred 0.2 days earlier in mature hinds and 0.3 days earlier in 2- and 3-year-old hinds. This effect may partly explain their observations and those of Bray and Kelly (1979) that 2-year-old hinds calved 1 – 2 weeks later than older hinds. These findings highlight the importance of good nutrition prior to mating for high fertility and concentrated calving.

A third point noted by Hamilton and Blaxter was that weaning of calves before mating of hinds resulted in a reduced spread of calving without any effect on fertility. According to Loudon *et al* (1983) suckling may delay calving through later mating over and above any effects of liveweight by itself. These findings, together with the advantages of separate management of calves during autumn, are arguments for weaning before mating.

Stag nutrition

Stags lose weight during the mating season. In Kelly and Moore's study (1977), dominant stags in multiple-sire herds lost an average of 15%, subordinate stags 8%, and stags in single-sire herds 12% of their liveweight at the start of mating. These losses correspond directly to the amount of energy-expensive (sexual and agonistic) behaviour shown and inversely to the amount of feeding done by stags in each class (Table 2). The drop in stag liveweight over the rut is related to loss of body fat (Drew 1985). Stags need to be well fed after mating and over winter to avoid so-called "winter death", which is in effect an exposure/starvation syndrome (McAllum 1980).

Herd structure

In wild herds (Clutton-Brock *et al* 1982) stags compete for groups of hinds during a short period

Table 2: Incidence of sexual plus agonistic behaviour and feeding by stags during the early and main phase of the mating season; results expressed as % of total daytime hours of observation (Bray unpubl.)

	Accumulated observation time (h)	Sexual and agonistic (%)	Feeding (%)
Single-sire stags ($n = 3$)	46	36	10
Dominant stags ($n = 4$)	72	55	6
Subordinate stags ($n = 5$)	72	13	17

each autumn. The most dominant stags control the largest harems and perform most mating. Mating activity in the wild red deer population on the island of Rhum has been well described (Lincoln *et al* 1970; Lincoln and Guinness 1973; Clutton-Brock *et al* 1977; Gibson and Guinness 1980a, b) and stag dominance is associated with age, body weight, antler size and complexity, and roaring ability (Lincoln 1972; Clutton-Brock and Albon 1979; Clutton-Brock *et al* 1979; Suttie 1980). In any 1 year the majority of wild stags do not mate at all.

Similar patterns are seen in extensively farmed herds, but they are modified under intensive farming conditions. In a study of stag behaviour at mating on N.Z. farms (Bray and Kelly 1979; Bray unpubl.) harems were not maintained when more than 6 stags were run with hinds in small paddocks of less than 10 ha with no cover (flat terrain, no trees). Any harems that were formed were short-lived because the stag was unable to keep all the other stags away and prevent hinds from leaving to join nearby groups. As a result hinds tended to congregate in loose groups with stags dispersed among them (Fig. 1). Despite the lack of stable harems and the proximity of hinds to all stags, the dominant stag still maintained considerable superiority: in a herd of 182 hinds and 12 stags, 1 stag performed 58% of observed services (Bray and Kelly 1979).

Harems were more stable in small paddocks when fewer stags were present (Fig. 2). In large herds dominant stags accumulated very large harems (Table 3). Second-ranked stags held smaller harems in some herds (Fig. 2 *upper*) and some subordinate stags had access to hinds occasionally. Hamilton and Blaxter (1980) noted that sharing of hinds was more likely between stags of similar rank than between stags widely separated in the dominance hierachy.

Stag mating ability

Bray and Kelly (1979) reported that 1 stag joined with 83 hinds sired 73 calves in the first 35 days of mating. Dominant stags in large multiple-sire herds were estimated to have sired similar numbers (Table 3). However, 4 stags (2, 3, 5, and 7b in Table 3) exhibited signs of sexual exhaustion. Their mount to service ratio early in the mating period (13/11 = 1.2) was similar to that recorded for other stags over the whole period (38/36 = 1.1), but later their performance declined (166/7 = 23.7). Calving records indicated that conception rates were reduced when high mount to service ratios were recorded for at least 3 of the stags (Bray and Kelly 1979).

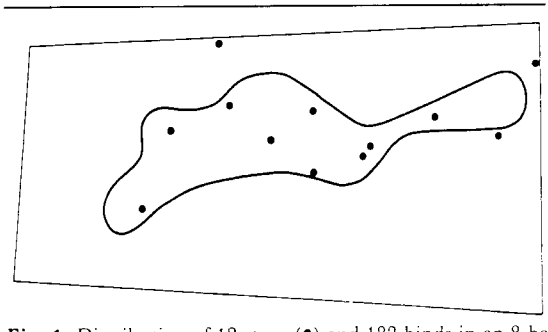

Fig. 1: Distribution of 12 stags (•) and 182 hinds in an 8 ha paddock with no cover (line depicts limit of hind group).

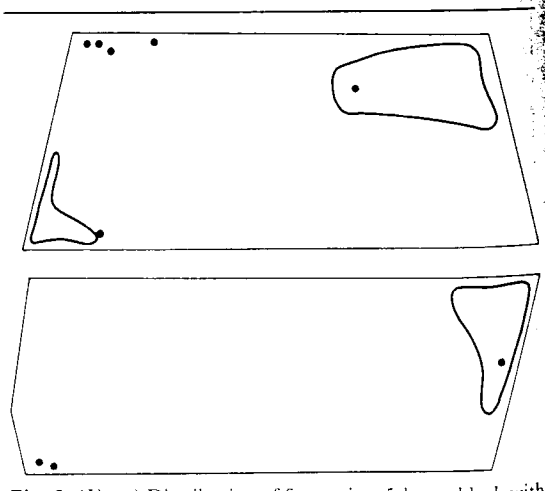

Fig. 2: (*Upper*) Distribution of 6 stags in a 5 ha paddock with no cover. (*Lower*) Distribution of 3 stags in a 5 ha paddock with no cover.

Table 3: Reproductive success of individual stags in 8 herds (Bray unpubl.)

Herd/stag[1]	Numbers in herd: Stags	Numbers in herd: Hinds	Numbers held by dominant stag: Harem size[2]	Numbers held by dominant stag: Calves sired[3]
1	1	83	83	73
2	2	77	77	48
3	2	109	109	40
4	3	150	100	72
5	3	183	183	47
6	5	108	108	51
7a	2	196	140	51
7b			196	67
8a	6	152	74	71
8b			75	32

[1] In herds 7 and 8 different stags occupied the dominant position in the same herd at different times

[2] Average harem size during period of dominance

[3] Estimated from number of calves born in period corresponding to the period of dominance and proportion of hinds in the harem

In spite of their reduced ability to serve hinds, these stags retained their dominance and maintained harems in the face of competition from subordinate resident stags and from freshly introduced stags. It was necessary to remove the affected stag from the herd to ensure that another stag took over the mating load.

Management recommendations

On the basis of the above information recommendations have been made to deer farmers wishing to maximise both fertility and rate of genetic gain for productive characters (growth rate and velvet antler production). It is recommended that:

- Stags should be selected on recorded productive performance (Butler 1983) and groups of about 50 hinds should be joined with single sires for rapid genetic progress and positive sire identification.
- To minimise the effects of possible stag infertility, individuals (primary sires) should be withdrawn immediately after the peak of mating (late April) and replaced by a fresh stag (secondary sire).
- If single-sire mating is not used, sufficient stags should be joined to prevent harem size exceeding 50 hinds. Even in small paddocks this may require 10 stags.
- The dominant stag in a multiple-sire herd should be replaced after the peak of mating. If this stag cannot be removed, more stags should be added to spread the mating load.

Appendix 1 outlines a schedule of mating and calving management which has been applied successfully for single-sire mating of intensively farmed red deer at Invermay (Moore unpubl.).

Calving and Rearing

Behaviour of wild deer

Red deer hinds in the wild follow a common ungulate pattern and leave their normal range to seek isolation before giving birth (Clutton-Brock and Guinness 1975). They remain apart from the hinds with which they normally associate for 3 weeks or so. During this period the calf sucks several times a day (Clutton-Brock *et al* 1982). After sucking the young calf will move to cover where it remains lying while its mother moves away to feed. The maximum separation recorded by Clutton-Brock and Guinness (1975) was over 1 km, and most hinds fed more than 100 m from their calf. Suckling bouts occur when the hind returns to the hidden calf. When 10 – 15 days old the calf begins to follow the hind to the feeding grounds and by the time it reaches 3 weeks of age the pair have rejoined the hind group.

Implications for farmed deer

High stocking densities and lack of cover on farms can prevent a hind finding an isolated spot in which to give birth and where the calf can hide during the first weeks of life. Observations at Invermay in 1973 and 1974 indicated that these conditions can have adverse effects on hind behaviour and mortality of newborn calves could be high (Kelly and Whateley 1975; Kelly and Drew 1976). It is noteworthy that the hinds studied were transferred from an extensive deer farm onto an 8 ha block for intensive farming only 6 weeks before calving in 1973; the unsettling effect of this together with subsequent disturbance of hinds and calves for research recording could have induced the behaviour observed. A few hinds showed extreme intolerance of alien calves on occasions by biting them and flailing them with their forefeet, to the extent that some were killed. At the other extreme some hinds allowed alien calves to suckle. Both these observations have been confirmed in other herds, but generally the incidence of such abnormal behaviour is low in farm-adjusted deer. It is now generally accepted that calving management should entail a minimum of disturbance and interference, especially with less tame hinds.

Although high calf mortality rates of about 25% were recorded in the first years (1973 – 74) of the Invermay deer farm, subsequent levels here and in other farm herds have been considerably lower (Table 4). However, instances of high mortality have been associated with poor nutrition during pregnancy and disturbances during calving (Kelly

Table 4: Calf mortality in farmed red deer herds (% young calves dying/calves born)

	Herds (*n*)	Calves born/herd	Average mortality	Reference
Research herds	1	67	25	Kelly & Whateley 1975
	3	12 – 20	24	Kelly & Drew 1976
	1	56	16	Arman *et al* 1978
	11	14 – 30	7	Moore unpubl.[1]
Commercial herds	8	61 – 344	9	Bray unpubl.
	97	20 – 300	8	Asher unpubl.

[1] Invermay Deer Farm 1979 – 82

et al 1984). By way of comparison, Guinness *et al* (1978) reported an average 18% mortality in the Rhum study population.

In most respects the lying-out and sucking behaviour of red deer calves on farms (Kelly and Whateley 1975; Kelly and Drew 1976) is similar to that of wild deer calves (Clutton-Brock and Guinness 1975). The Invermay experience has highlighted the strong preference of calves to move to and hide in cover; on occasions up to 8 calves have been observed lying under 1 pine branch when other cover was sparse. Although cover in a calving paddock is not absolutely essential, its provision is strongly advised especially with "wilder" hinds; also it provides shade and shelter for calves. Absence of suitable cover for young calves can cause them to go through fences in search of a hide (Moore unpubl.).

Rearing

On intensive farms the separation between feeding hinds and hidden calves noted by Clutton-Brock and Guinness (1975) is not possible with small paddocks and high stocking rates, or necessary with adequate feed supplies available close to the calf. Hence it is not surprising that farm hinds remain close enough to their lying calves between suckling bouts for calves to initiate some of the sucking (Moore and Cowie unpubl.).

Guinness *et al* (1979) reported that in the Rhum study red deer calves in the wild were usually weaned by the end of their first winter but continued to associate with the hind subsequently. This association might continue for another year or 2 in the case of male calves, whereas female calves often associated with their dam throughout her lifetime. Consequently hind groups were typically composed of a hind, her female descendants, and their dependent offspring.

In contrast farmed deer calves are often weaned and separated from their dam at 3 months of age and raised in single-sex, single-cohort groups to maturity. This is done to facilitate anthelmintic treatment (Mason 1981) and attainment of desired growth rates. No problems associated with this change in rearing have been recognised.

On some farms calves are not weaned until after the rut when aged about 6 – 7 months. This practice is more common on extensive farms where mustering hinds with calves off large hill blocks is not easy. When feed supply on the hill blocks has become short in early winter it has been found that the deer can be enticed down into flat paddocks using supplementary feed such as lucerne hay and later yarded for weaning. Late weaning (post rut) has the disadvantage, however, that calves are not drenched for lungworm control over autumn and the stress of separation occurs when weather conditions are likely to be poorer in early winter. Late weaning has been considered to have the advantage that hinds can "teach" their calves to eat winter supplements before weaning. This is of course desirable if calves are to be confronted with a sudden and complete dietary change at weaning; however, with early weaning calves can be run on pasture to which they are accustomed and supplements can be introduced gradually as pasture availability declines in late autumn.

Care is required to minimise stress on calves at weaning. Holding the calves in yards for 4 – 5 days with hand feeding of lucerne hay will prevent considerable fence pacing and helps calves become used to the yards and to humans (Moore 1982). The weaning paddock should be at least 1 paddock away from any hinds, but a few old tame hinds can be run with the weaners to help quieten them. Supplementary feeding by hand in the paddock can also be used to quieten the weaners.

Hand rearing

Young calves which have been orphaned or captured in the wild have been successfully hand reared (Fennessy *et al* 1981b). Compared with ewe or cow milk, red deer milk has a high fat and low lactose content; ewe milk, being somewhat lower in lactose than cow milk, is preferable as a replacement.

Bottle-reared calves generally become a nuisance

when run in farm herds, as they can hinder shifting and yarding deer by not running with the herd. Hand-reared stags can become very dangerous to people and difficult to handle over the rut. Less tame calves can be reared by feeding milk from a bucket rather than a bottle. A suspended 4 litre bucket with 4 teats inserted around the base is suitable. In this way bucket rearing of deer calves was used extensively at Glensaugh to establish the research deer herd (Blaxter *et al* 1974).

Removal of Antlers

Under intensive farm conditions it is essential to remove antlers from stags to prevent them injuring or killing other deer or humans or wrecking fences. Antlers must also be removed before transporting stags. Stags destined for slaughter need to have their antlers sawn off just above the coronet so that no sharp points remain to bruise or injure other stags during transport and before slaughter. It is safer and easier for both farmer and stags to remove the antlers towards the end of their growth before the tips become hardened and sharp.

Stags begin casting their antlers (stubs) in late August or September. Younger stags cast later with the rising 2-year-olds casting their antlers mainly during October. If the antler in velvet is to be sold commercially the optimum time for removal is after about 40 – 50 days of growth for stags aged 2 years depending on market requirements, and after 60 – 75 days for older stags. At this latter stage of growth the main beam is about to divide into the top or royal tines. It is advisable to draft large herds of stags into smaller groups of 20 – 40 according to their antler casting periods, so that the stags in each group are ready for antler removal at about the same time making management and handling easier. It is important to avoid overcrowding stags in velvet antler during yarding and handling: if stags are crowded together they will stand up on their hind legs and box each other with their forelegs, often resulting in damage to their antlers in velvet.

Stags must be given an adequate amount of analgesic before velvet antler removal. Rompun (Bayer) is the tranquilliser most commonly used at doses of 30 – 60 mg/100 kg liveweight; it is more effective when the stags are held in darkened pens. Nerve blocks on the infratrochlear and zygomaticotemporal nerves (Adams 1981) are administered using 2% xylocaine before a tourniquet is applied around the pedicles and the velvet antlers sawn off just above the coronet. Tourniquets can be released 5 – 10 minutes after antler removal (Fennessy and Moore 1981). The development of a reversal agent for Rompun means that stags can be removed from the yards shortly after velvetting (Mackintosh and van Reenen *in press*).

Immediately antlers are removed they should be hung upside down to avoid blood loss and allowed to cool. Later the antlers in velvet should be weighed for production records and then sealed in plastic bags for freezing. (The frozen velvet antler is sold to agents of processing plants where it is usually dried prior to export.)

The velvet antler production from a cohort of red deer stags born at Invermay is shown in Table 5. Velvet antler production increases with age to maturity: 2-year-old stags produce about 1 kg of commercial quality velvet antler, whereas average stags aged 5 or 6 years produce 2.3 – 2.5 kg (Moore unpubl.).

Table 5: Means for date of antler casting and velvet antler production (± s.d.) for a cohort of 36 red stags from 1 to 5 years of age

Age (years)	Casting date	Velvet antler (kg)	Days of growth[1]
1	–	0.29[2] ± 0.13	–
2	25 Oct ± 7	1.01 ± 0.19	56 ± 0.9
3	27 Sep ± 9	1.60 ± 0.29	58 ± 4.4
4	14 Sep ± 7	1.93 ± 0.32	61 ± 5.0
5	4 Sep ± 7	2.17 ± 0.33	60 ± 4.3

[1] Days from antler casting to removal of velvet antler
[2] Hard antler

Some regrowth of antlers often occurs 3 – 4 weeks after the first cut, usually only from parts of the pedicle periphery without invasive healing of the cut antler surface. The shape of this antler regrowth is usually atypical; however, in some stags, particularly if the first cut is taken relatively early, regrowth of normal antler shape occurs. If not removed, this regrowth is arrested in February and the velvet stripped as in the normal antler growth cycle. It is advisable and easier to remove regrowth in late January before it hardens completely.

Venison Production

Currently few deer are being slaughtered for venison with newly established deer slaughter premises working below capacity. Supply and demand for breeding hinds and live stags for velvetting has meant that live animal prices far exceed their venison value. This situation will eventually change unless research shows antler in velvet to have extraordinary medicinal value to the Western World. Demand for velvet antler in New Zealand's main market, Korea, is somewhat

unstable and only partly predictable on a short-term basis each season. When returns for velvet antler decline the farmer will face decisions on what stock to slaughter and when. Stags with poor velvet antler production should be culled first; data in Table 5 show that there is a wide range in production.

The age at which stags are slaughtered for venison will depend on several factors. For profitable farming, feeding and other farm costs have to be compared with venison grade prices to optimise net returns. Stags over 2 years old should not be sent for slaughter if overfat, because the marketable virtue of venison is its leaness. It should be borne in mind, too, that at the mating period stags are difficult to yard, transport, and slaughter and considerable bruising occurs.

In a straight venison production system for young stags optimum slaughter age is considered to be 15 or 26 months. Costs of antler removal from stags at 26 months of age before transport for slaughter may well favour net returns from slaughter at 15 months. Handling stags at 15 or 26 months of age is not a problem and their carcass fat levels are low, 6% at 12 months and 12% at 27 months (Drew 1977).

Older stags are not naturally lean over summer – early autumn; by November (late spring) they can have carcass fat levels of 18% (at about the time for velvetting) and by March over 21% fat (Drew 1985). By June carcass fat levels have dropped to 1 – 2% through lack of appetite over the rut. For lean venison, older stags can be slaughtered post rut as soon as their mutual intolerance and fighting has abated.

Disease Prevention

As with other farm animals the health of deer can be greatly affected by management, particularly stocking density and nutrition (McAllum 1981). The most frequently occurring animal health problems reported by deer farmers are malignant catarrhal fever, yersiniosis, lungworm, stress, gastrointestinal parasites, lameness, facial eczema, and tuberculo (Gladden 1981). In a survey of deer diseases o South Canterbury deer farms postcapture myopath (17% of all deaths) and accident (16%) ranked hig as causes of death (McAllum 1981).

Published information on parasitism in farme deer is scant (Watson and Charleston 1985), bu lungworm (*Dictyocaulus viviparus*) is the mos important parasite on deer farms throughout Ne Zealand. Calves during their first autumn and recently captured deer from the wild are most susceptible (Mason 1985), but drenching of calves every 3 weeks over autumn to early winter will control lungworm.

To prevent clostridial diseases, breeding hinds are vaccinated in late pregnancy and young stock after weaning. Preventive vaccination is cheap and generally considered good insurance. Where facial eczema is known to occur in domestic livestock deer farmers are advised to take preventive measures when warnings are issued based on spore counts of sporidesmin and climatic conditions; such measures include removing stock from toxic pasture and spraying the pasture with fungicide. To control tuberculosis (Tb) in farmed deer it has been recommended that all deer be Tb tested with the cattle tuberculin test, particularly any animals coming onto a farm, and that reactors be destroyed (McAllum 1981). Ryegrass staggers has recently been diagnosed in imported Canadian wapiti at Invermay (Mackintosh *et al* 1982); as with domestic stock, deer should be shifted off infected pasture and not be subjected to any stress.

Where deficiencies of minerals such as selenium or copper occur, animals are treated by injection or dosed orally to prevent white muscle disease and enzootic ataxia respectively.

Acknowledgement

The authors gratefully acknowledge the assistance of Mr A Searle, Invermay, in collecting some of the data presented for the Invermay Deer Farm.

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