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Introduction

Antlers are grown by the males of most deer species. They are temporary bony structures arising from specialised regions on the skull, the pedicles. They differ from horn in that they are regrown annually (in most species) and, in their mature state, are composed of inert bone (calcium phosphate) rather than keratin (i.e. hair tissue).

Antlers serve a function in sexual display and territory defence, and their shape and size are determined by a number of environmental and genetical factors. Overall antler shape is species specific and genetically determined. Fallow deer differ from most other species in that their antlers are typically palmated (see Figure 1). In fact, this was the main reason for consigning fallow deer to a different genus (*Dama)* from red deer, Wapiti, etc (*Cervus*) even though they have many other similarities.

Harvesting of velvet antler from fallow deer is not of major economic significance in New Zealand and in most farming operations antlers are considered to be of nuisance value only. They are generally removed prior to the rut each year. Intact, or simply as hard buttons (i.e. following velvet removal), antlers can lead to considerable management problems due to the aggressive nature of bucks during the breeding season.

The antler cycle

Fallow deer antlers are cast and regrown annually. Figure 1 illustrates the antler growth cycle of a mature fallow buck. Casting of old antlers (or buttons) occurs in late spring (late September - early October) in response to a marked reduction in testicular secretion of testosterone. At this time, the junction between the pedicle and the coronet (base of the antler - Figure 1) weakens due to the action of various enzymes, to the extent that the weight of the antler is often sufficient to cause separation. Both antlers are usually cast within a few days of each other. As buttons are considerably lighter than full antler, they frequently adhere to the pedicle for one or two weeks longer than is normal, even to the point where they eventually sit on top of newly growing antler tissue.

Generally, however, new antler tissue does not become apparent until 3-4 days after the old antlers have been cast. By day 7 from casting the newly developing antler is apparent as a soft velvet swelling about 0.5-1.0 cm thick and by day 20 there is clear differentiation of the brow tine bud and the 4-5 cm long main beam. By about day 35 the tip of the 12-15 long main beam shows a distinct swelling that soon leads to the emergence of the trez tine (fallow deer generally lack a bez tine). The trez tine bud is fully apparent by day 50 and there is a pronounced flattened swelling occurring at the top of the main beam. Over the next 50 days there is a rapid development of the palmation and further elongation of the brow and trez tines. By day 100 there is usually an indication of speller points (see Figure 1) differentiating on the rear and top edge of the palm. These spellers become fully differentiated by day 120. By this time the brow and trez tines have reached their ultimate length, and mineralisation of the whole antler is progressing rapidly. Between days 120-140 the antler retains its velvet covering but there is little outward sign of growth. However, during this time, antler mineralisation is nearing completion due to the influence of increasing testicular secretion of testosterone.

The outer velvet layer is stripped at about day 140 (i.e. early-mid February). The stripping occurs rapidly and is usually completed within two days.

The mature antlers are retained throughout autumn and winter, to be cast again in the following spring.

Antler size generally increases in each successive year; starting from short (2-30 cm) unbranched spikes in the first year, to heavily palmated, multi-tined antlers by fully maturity (8-12 years).

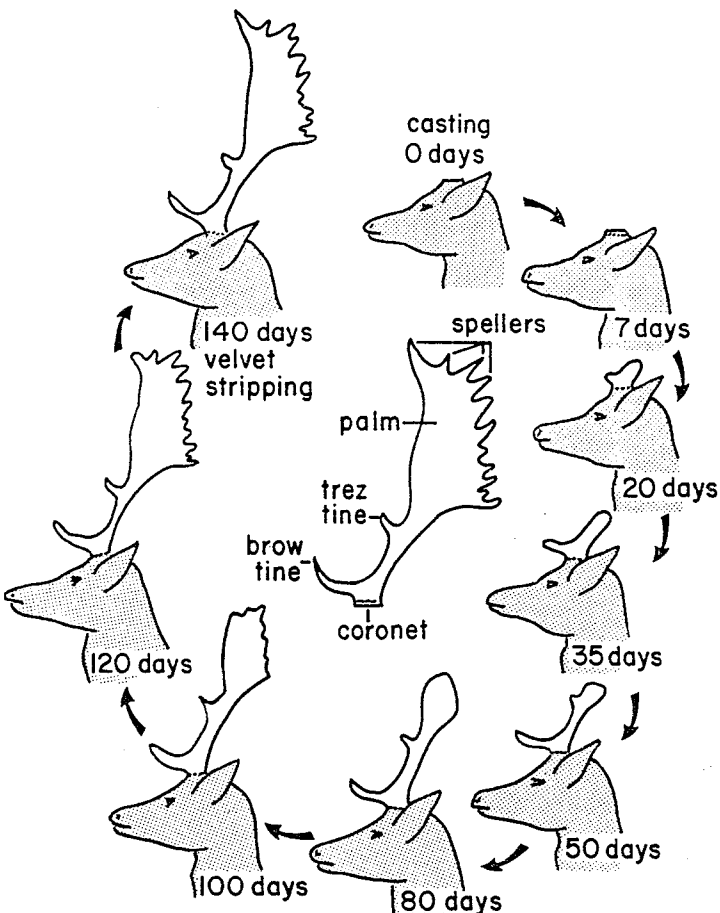

Figure 1: The antler growth cycle of mature fallow bucks.

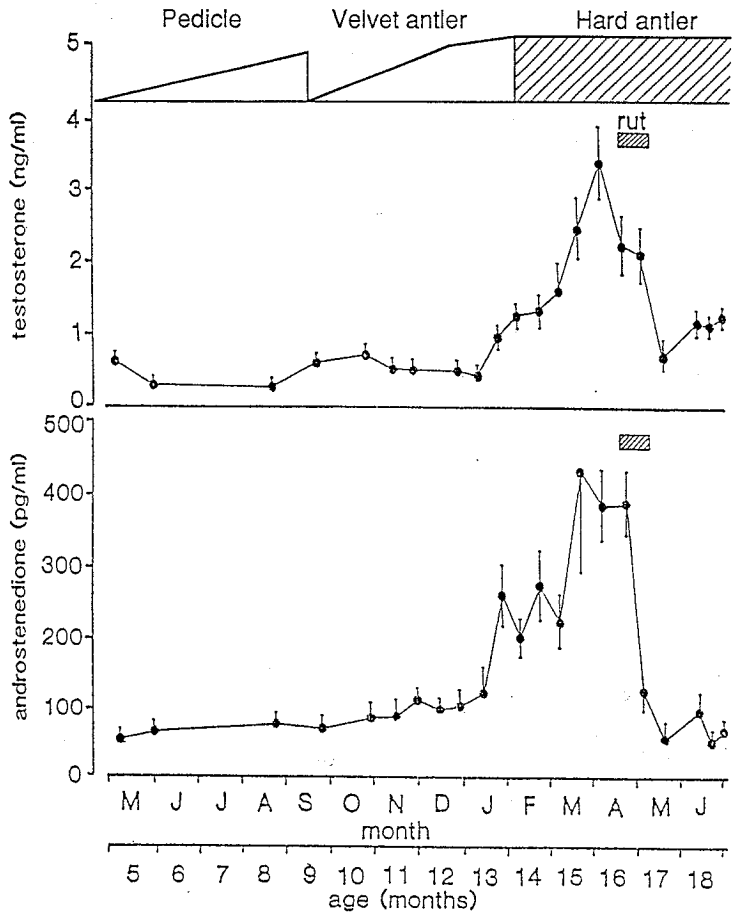

Figure 2: Schematic representation of pedicle and antler development of young fallow bucks in relation to actual changes in mean (± s.e.m.) plasma androgen concentrations between 5 and 18 months of age (n=21 bucks).

Development of first antlers

Pubertal development of fallow bucks occurs within the first 16 months of life. During the first winter and early spring (6-9 months) the gradual increase in testicular size is associated with increasing blood androgen (e.g. testosterone) levels (Figure 2). This stimulates directly the growth and proliferation of primordial cells on the frontal bones of the skull, eventually resulting in the development of the pedicles between 6-8 months of age (Figure 2). The first antlers arise and grow from the mushroom - like pedicles at about 8-13 months. The eventual

size of these antlers (spikes) is directly related to liveweight at 15-16 months of age. Bucks below 35 kg may develop spikes only 1-2 cm long, whereas 55 kg bucks may develop spikes up to 30 cm long.

Fallow spikers or "prickets" generally strip the outer layer of velvet in mid-January; 2-3 weeks earlier than adult bucks.

Effects of castration

As testicular androgens are required for the initiation and development of pedicles in the first year, castration prior to puberty will invariably arrest pedicle growth and consequently prevent antler growth. Typically, prepubertally castrated bucks outwardly resemble does (apart from the obvious presence of the pizzle).

However, post-pubertal castration does not prevent antler growth. As pedicles are already fully developed by puberty, the effect of later castration is to cause precocious casting of any hard antler, due to the rapid decline in blood testosterone concentrations. In the absence of testosterone, the velvet antler will never completely mineralise; therefore the annual antler cycle is abolished. Typically, the velvet antler eventually forms an amorphous mass, often termed "peruke" antler. Administration of exogenous testosterone to post-pubertally castrated bucks causes rapid mineralisation of the antler, eventually leading to complete stripping of the outer velvet layer. However, the hardened antlers are cast once the testosterone is cleared from the blood stream, and the velvet antler will start to grow again.

Antler removal

For obvious management reasons, antlers are normally removed from fallow bucks run on intensive farms. They are removed either as velvet antler (i.e. living tissue) or as hard antler (i.e. dead tissue).

1. Velvet antler removal

If velvet antler is to be removed, either for commercial gain (i.e. saleable velvet) or simply for ease of management, it must be done under humane conditions and veterinary supervision. For ethical and legal reasons the animals must receive local anaesthesia *at least.*

Saleable velvet is usually harvested in early-mid November, about 35 days after casting (see Figure 1). At this stage of development the trez tine has yet to differentiate from the main beam. Cut-velvet weights range from 150-500 g per buck but is seldom worth more than $30-$40/kg because of its small size. However, later-cut fallow velvet (i.e. >50 days) is longer but is generally too mineralised to be of any value.

Because saleable velvet is cut at an early stage of development it is usual for regrowth to occur. Ideally this should also be removed before the bucks become aggressive in mid-late February.

If velvet antler is to be removed-to-waste (i.e. not for sale) it is preferable to remove it later in the season and at a later stage of growth (e.g. 80-120 days) to decrease the incidence of regrowth. However, many handling systems have forms of restraint that are too narrow for bucks carrying wide racks of antler (e.g. after 100 days of growth) and it may be necessary under these circumstances to cut velvet antler earlier.

Spikes from yearling bucks should be removed in late December-early January. Earlier cutting (e.g. November) will lead to considerable regrowth, requiring further cutting. If left too late (e.g. late February) the bucks will be very aggressive towards each other. Remember that yearling bucks tend to harden their antlers 2-3 weeks earlier than mature bucks.

2. Pedicle removal

It has become common practice to remove both pedicles and antlers from yearling bucks that are destined to be sent to the deer slaughter premise (DSP). This involved cutting flush with the skull; such that no projections remain. It must be stressed that this also should be performed under local anaesthesia. It is generally performed in late December - early January and is very effective in preventing fighting injuries during yarding and transportation. While the bucks will show no sign of pedicle/antler tissue up to 20 months of age, *pedicle removal at 12-13 months of age will not prevent antler growth in subsequent years.* In fact, bucks can grow apparently normal antler 2 years after this form of pedicle removal. However, the first subsequent crop of antler (i.e. 1 year after pedicle removal) is often misshapen.

Clearly, it is difficult to obliterate all pedicle tissue at 12-13 months of age, and they are capable of regeneration.

3. Hard-antler removal

Hard antler is non-living tissue and can be removed humanely without recourse to anaesthesia. However, bucks in hard antler are very aggressive towards other deer, particularly when being yarded. It is often preferable to have a veterinarian remove velvet antler in summer than to attempt to yard hard-antlered bucks 2-3 months later.

Polling to inhibit antler growth

While removal of pedicles at 12-13 months of age does not inhibit subsequent antler growth, "polling" bucks as weaners (i.e. cauterising the primordial pedicles with an electric disbudding iron) appears to inhibit completely and permanently growth of both pedicles and antlers in most individuals. The success of the procedure depends upon the degree of primordial tissue (periosteum) destruction, and this is achieved with considerably less trauma on five-month-old bucks (at approximately 25 kg liveweight) for which pedicle primordia are palpable but not necessarily visible, than for older bucks with clearly visible pedicles. Furthermore, as most weaner bucks will eventually be slaughtered before the onset of aggressive behaviour at 14-15 months of age, only those weaners intended for use as sires need to be treated. It is likely that the top 20% of weaner bucks (in terms of liveweight or any other selection criteria) can be selected at or close to weaning. These are the animals that should be kept as potential sires and are the likely candidates for polling.

The polling procedure outlined below is intended for use by veterinarians as it is a reasonably skilled operation that, for ethical reasons, requires the use of local anaesthetics.

1. The polling procedure

- draft individual bucks for polling in May (5 months of age) or at 25 kg liveweight.
- pre-heat the disbudding iron (mains electric or battery operated calf disbudding iron with a 2 cm diameter concave cutting disc).
- clip the hair covering the pedicle site to highlight the primordial pedicles.
- administer a local anaesthetic to the general region of both primordial pedicles.
- after allowing time for the local anaesthetic to take effect, place the concave disc of the hot disbudding iron directly over each of the pedicles in turn; apply pressure while rotating the disc slightly and remove the resulting wad of skin to expose the bony structure of the developing pedicle.
- with the cutting edge of the disc, remove the bony pedicle structure flush with, or even slightly below the level of, the frontal bone, making sure to cut away from the animal's eye.

- complete the operation by cauterising the general area over a 1.5 cm radius. It is important to eliminate all primordial pedicle tissue at this stage, otherwise small antlers may develop later in life.

- no further treatment is required, however, it may be wise to vaccinate fawns agains clostridial diseases several weeks prior to treatment.

2. Success rate

Of 29 weaner bucks treated in either 1981 or 1982, three developed a small weak antler on one side by four years of age. The other bucks have remained polled.

3. Performance of polled bucks

Polled bucks have been used as sires for the last three breeding seasons. Trials have been conducted in which does and polled bucks have been yarded together up to eighty times during the mating period. During mustering and yarding the bucks did not exhibit aggession towards the does. Needless to say, the successful outcome of these trials was partly dependent upon the ability to yard deer frequently without aggression related problems. To this end, the polled bucks were worth their weight in gold.

However, polling does not completely inhibit aggression in fallow bucks. Rival polled sires will frequently fight during the rut if they share close territorial boundaries. Furthermore, adult polled bucks in bachelor groups also will have sparring matches during the autumn and winter months. The head to head confrontation of two polled bucks is an amusing spectacle to observe, as the forward momentum often causes one buck to complete straddle its opponent in the absence of locking antlers.

Frequent sparring generally results in little more than temporary, partial baldness. However, some deaths were experienced in a bachelor group of polled bucks that were *directly attributable to fighting* in the paddock even though they showed little aggression when yarded together. This problem was alleviated by breaking down the bachelor herd structure into buck pairs (in the absence of a large, broken paddock on the Ruakura Deer Unit) for the remainder of winter, as it appeared that groups of bucks were "ganging up" on individuals. This was probably induced by a high stocking rate within small (0.25 ha) paddocks and the fact that all the bucks were of the same age and approximate liveweight, leading to a fragile hierarchal structure. It is highly likely that, given the same conditions, the same problem would have occurred with antlered and velveted bucks.

4. Recommendations for the management of polled sire

- single sire mating of small (<35) numbers of does in each group is probably preferable to multi sire mating with larger groups of does. Regardless of antler status, this tends to reduce valuable energy being lost defending territories. Also it ensures that top bucks (i.e. selected by merit) do actually service does and sire offspring.

- if multi sire mating is practised, ensure that each buck has an adequate area for maintaining a defendable territory that does not overlap with that of other bucks.

- never run polled *and* antlered bucks together, especially during the rut.

- if bucks (polled or antlered) are to be removed from mating groups at the end of the main rutting period (i.e. May-June), maintain them in loose bachelor herds; do not force them into high density herds over winter. It may be pertinent to overwinter them in large broken (e.g. some bush cover) paddocks. However, still provide high quality feed as their body reserves of fat are depleted after the rut.

- present experience indicates that yarding of does in the presence of a polled sire buck presents few problems. However, if a particular buck becomes unusually aggressive it may be wise to eliminate him as a future sire prospect. Even so, it is unlikely than an aggressive polled buck will do as much damage as a buck bearing antlers or vestiges of antlers.

Polling is not the complete answer to eliminating buck aggression problems on the farm. However, it may go a long way to reducing stock injuries during yarding, and as such deserves at least some consideration as a management tool. The success of the technique in permanently eliminating antler growth has yet to be fully evaluated but present indications are that, providing the operation is performed properly, antler growth is eliminated until at least four years of age. If the practice is to be adopted, the polling operation should be performed under veterinary supervision and will be no worse than velvet antler removal.