**The third article in a series**

**How do domestic animals differ from wild ones? Ease of handling might be the first difference which comes to mind, but at least equally important is the control of reproduction. In deer, this means determining the type and number of calves and when they will come.**

**In this article Peter Fennessy and Peter Dratch of Invermay Agricultural Research Centre, Mosgiel, review developments in the manipulation of reproduction in deer and the potential application of these developments on farms.**

**Though techniques like early breeding, embryo transfer and artificial insemination are widely used on livestock around the world, getting them to work in deer has been largely New Zealand's challenge. Many of the early experimental results have been reported in The Deer Farmer, and references are included for those wanting more details.**

Peter Dratch

Peter Fennessy

## Directions in deer breeding...

# Deer have got the

## *Can we make it better?*

THE QUITE rigid yearly reproductive cycle is one of the great difficulties in working with social deer originating in temperate climates (i.e. Reds, Fallow and Wapiti). Anyone who reads the newspaper knows of the frigid winter they've had in Europe and the United States this past year. Deer over there must have got it right by not having their calves at that time of the year. It is no use trying to convince your deer that they now live in a milder climate and will be well fed in any case, and that the season in which they breed doesn't matter as much. Before the breeding season can be brought forward, the hind must be told by her body or brain that it is autumn.

At Invermay, Geoff Moore has had success this past season in breeding mature dry hinds six to eight weeks early through hormone treatment. We have also had success in getting yearlings to calve about a month early. To have widespread use on deer farms, a method must prove effective on all classes of hinds. This year the deer reproduction programme at Invermay will seek to bring the calving date forward in lactating hinds as well as dry hinds and yearlings. Although the basic steps of hormone treatment are simple, in order to understand the logic of treatment it is necessary to understand a bit of deer physiology.

The great reproductive innovation of mammals, such as deer, was the internal development of eggs, less exposed to both weather and predators. The eggs are not scattered at random around the ovaries but are located within structures called follicles. Ovulation is the time when a mature egg ready for fertilisation is released from the follicle to begin the journey from the ovary, down the fallopian tube, to the uterus.

The follicle which has released the egg turns into the *corpus luteum.* This structure produces a hormone, progesterone, which plays a crucial role in maintaining pregnancy. If the hind does not get pregnant, the *corpus luteum* regresses and stops producing progesterone.

The drop in progesterone allows two hormones from the pituitary gland to further stimulate some of the follicles on the ovary to grow. One of the hormones is called, aptly enough, follicle stimulating hormone (FSH); the other is lutenising hormone (LH).

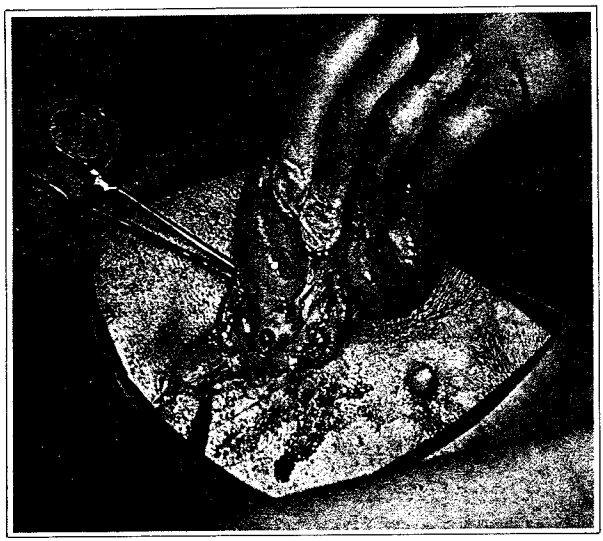
The major developing follicle produces oestrogen, which causes the hind to come on heat – that is, to show oestrus. Progesterone also has a role here; the brain must have been primed with progesterone in order for the oestrogen to have the effect of causing oestrus. The hind then comes on heat prior to ovulation.

Our treatment to advance the breeding season is to mimic these events, giving the hind the hormonal messages she would normally give herself a few weeks later. Prior to the start of the normal breeding season, there is no *corpus luteum* present. We therefore have to convince the hind that she has one by treatment with progesterone – we use an intravaginal device which releases progesterone (one which the hind cannot yank out; Red deer have nimble necks and tongues). We withdraw the device after 12 to 14 days thus mimicing the normal decline of the *corpus luteum.*

Experience has taught us that giving progesterone alone before the breeding season is usually insufficient and we need to provide other hormones as well. The hormone in general use is pregnant mares serum gonadotrophin (PMSG) which comes, of course, from pregnant mares. This hormone is much cheaper that LH and FSH, but acts on the hind in a similar way. It is probably the FSH-like component of PMS which is important in the treatment to advance breeding.

The alternative to mimicing the hormonal events which prompt breeding is to use the hind's own cues to start this hormonal sequence. In Red deer, as in sheep and many other mammals, the female uses for her seasonal

# timing right



*Reproductive tract of a Red hind showing the ovary corpora lutea. (Exposed in the course of embryo transfer surgery.)*

clock the decreased day length after the summer solstice. Therefore if we could convince the hind (or the stag – he uses the sun too) that the days were getting shorter, we should be able to start them breeding sooner.

This has been the basis of an experiment carried out at Lincoln College by Jim Webster and Graham Barrell. They simply brought yearling hinds into darkened yards in the late afternoon for a few weeks in late summer; the hinds responded by mating and calving early. More importantly, the same effect was achieved by treating other hinds with a hormone called melatonin. It is the increased production of melatonin as days shorten which informs the hind that the timing is right to turn on her reproductive hormones. While housing hinds is generally impractical, melatonin treatment could soon have a place on deer farms.

So far we have emphasised hinds. However, the stags must be ready and willing as well to have any success in the breeding game. There are at least three possibilities here – put stags in the dark, treat them with melatonin, or do nothing. Thus far we have done nothing – consequently not all stags are willing, depending on the libido of individuals. In Scotland, however, Gerald Lincoln and John Fletcher have successfully used melatonin implants to advance the rut in stags[1] and we will be working on similar approaches next year.

Such methods are particularly relevant to farmers who are attempting to cross Pere David stags with Red hinds. The Pere David normally ruts in summer (January in New Zealand) whereas Red deer females normally have little to do with males until late March. Therefore, once Pere David stags are adjusted to our environment and rut in summer, the Red hinds will have to be hormonally treated to induce oestrus and ovulation and thus mate at this time. Hopefully, the offspring of these matings will breed early without the necessity of hormonal treatment.

## Embryo transfer

When we left the egg, it was moving from the ovary to the uterus down the fallopian tube. There egg meets sperm: Those sperm which have successfully completed the journey from the vagina through the cervix to the uterus and up the fallopian tube. Fertilisation takes place in the fallopian tube (exactly when we do not yet know in Red deer) and from here on out the fertilised egg is an embryo. The transfer of embryos between hinds is the next area of reproductive manipulation.

Gilbert van Reenen introduced the topic of embryo transfer in The Deer Farmer last year[2] and since then further experiments have been carried out at Invermay. Recovering embryos from cows has become routine, by flushing the uterus a few days after mating. By skilful manipulation of the reproductive tract, the uterus is filled with solution, and then the solution with eggs is recollected. The eggs are then examined under a microscope to be certain they have been fertilised. If so, they are transferred to another cow, the recipient. Placing an embryo into the uterus does require surgery on the recipient. It is the non-surgical method of recovery, however, which has led to the widespread use of embryo transfer in the cattle industry.

The much smaller size of Red deer makes it difficult to apply these same methods – the basic problem is being able to manipulate the reproductive tract via a smaller rectum. It can be done by operating on the hind, but surgery increases the risk to valuable embryo donors. The larger size of Wapiti makes flushing easier in these animals, and indeed embryos have been recovered non-surgically by Dalstud veterinarian, Dr Eddie Dixon.

For the deer industry, embryo transfer offers the possibility for much greater use of exceptional hinds, by greatly increasing her number of calves. In the event of restriction ▷

▷ on the importation of live deer from overseas, it would still give us access to the worldwide deer gene pool. Clearly, the necessity of surgery currently makes embryo transfer both expensive and risky for deer farmers. Even when cost and risk are reduced, to be worthwhile the hind providing embryos must be an exceptional performer mated to a proven elite stag.

The procedure becomes more practical when the donor hind has more than the usual single embryo per cycle. This again involves hormonal treatment to induce superovulation – the production of numerous eggs in one oestrous cycle.

Embryo transfer is still very much an experimental technique in deer. We are still collecting basic information on the regulation of the oestrous cycle in the hind. Not the least of the difficulties is identifying which hinds are on heat. To this end we have people doing behavioural observations to determine how hinds relate to stags and other hinds during different stages of the oestrous cycle.

## Artificial insemination

We have already mentioned the normal route which the sperm takes to the egg. Artificial insemination (AI) involves collecting the sperm and bringing it to the recipients of choice. Sperm can be transferred either fresh or frozen (greater success usually comes from fresh sperm) and they are often given a boost further up the reproductive tract. Because the reproductive tract is a filter system, the further up the tract the sperm are introduced without traumatising the animal, the greater the likelihood of successful fertilisation.

Again, this topic has already been introduced in The Deer Farmer[3]. Compared with embryo transfer, artificial insemination has rapidly moved from the research farm into the industry. The major use thus far has been with imported semen of Canadian Wapiti on New Zealand Red hinds and hybrids. Jerry Haigh and Mark Shadbolt have had success with 40 per cent of Red deer hinds becoming pregnant with imported frozen semen (16 of 40 inseminations).

There is also a potential use for AI in breeding Red deer, making it unnecessary to send a top stag away or bring hinds to him. With AI, however, the success of the method is no better than the skill and experience of the operator, both to collect and preserve semen, and to inseminate hinds. Once again, it requires a deer farmer who can identify when his hinds are on heat.

Furthermore, as hinds are too valuable to risk unsuccessful insemination, chasers are generally used. In order to identify with certainty which stag is the father, blood-typing may come into practice as it has in both the racehorse and cattle industries. This will become increasingly important as herd standards are raised and the difference between sires is less obvious. Blood-typing in deer will be the subject of our next article.

### References

1. Lincoln et al 1984, Journal of Reproduction and Fertility 72, 339-343.
2. TDF Summer 1983-84, 14-15.
3. TDF Summer 1983-84, 13-15; Autumn 1984, 35-36.