REPRODUCTIVE PHYSIOLOGY OF MALE RED DEER

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SUMMARY

Male red deer are highly seasonal as revealed by their synchronised antler and sexual cycles culminating with the rut in the autumn. This annual cycle is under hormonal control with overall photoperiodic regulation.

INTRODUCTION

Not unexpectedly, the males of the various *Cervus elaphus* strains are also seasonal breeders, the highlight for the male being the rut in autumn. The annual male cycle follows extremes characterised by high feed intake and high weight gain in spring-summer, which decline under the influence of rising testosterone levels as the rut approaches. Following the rut when body fat reserves are virtually exhausted, intake increases so that bodyweight is maintained through winter. Some aspects of this pronounced seasonality relevant to reproduction will be discussed in this paper.

ANATOMY

The anatomy of the accessory sex glands of the male red stag is shown in Fig. 1. Further details are available in the paper by Lincoln (1971). The weight of the three principal organs the ampullae, the seminal vesicles and the body of the prostrate, all increase markedly in weight prior to, and reaching a maximum early in the rut. Very small bulbourethral glands (not shown) have also been identified (Wallace and Birtles 1985; J.M. Suttie and P.F. Fennessy unpubl.). Wallace and Birtles (1985) also proposed that the size of the ampullary lumen and the presence of sperm in stags slaughtered around the time of the rut suggest that the ampullae may act as a sperm reservior.

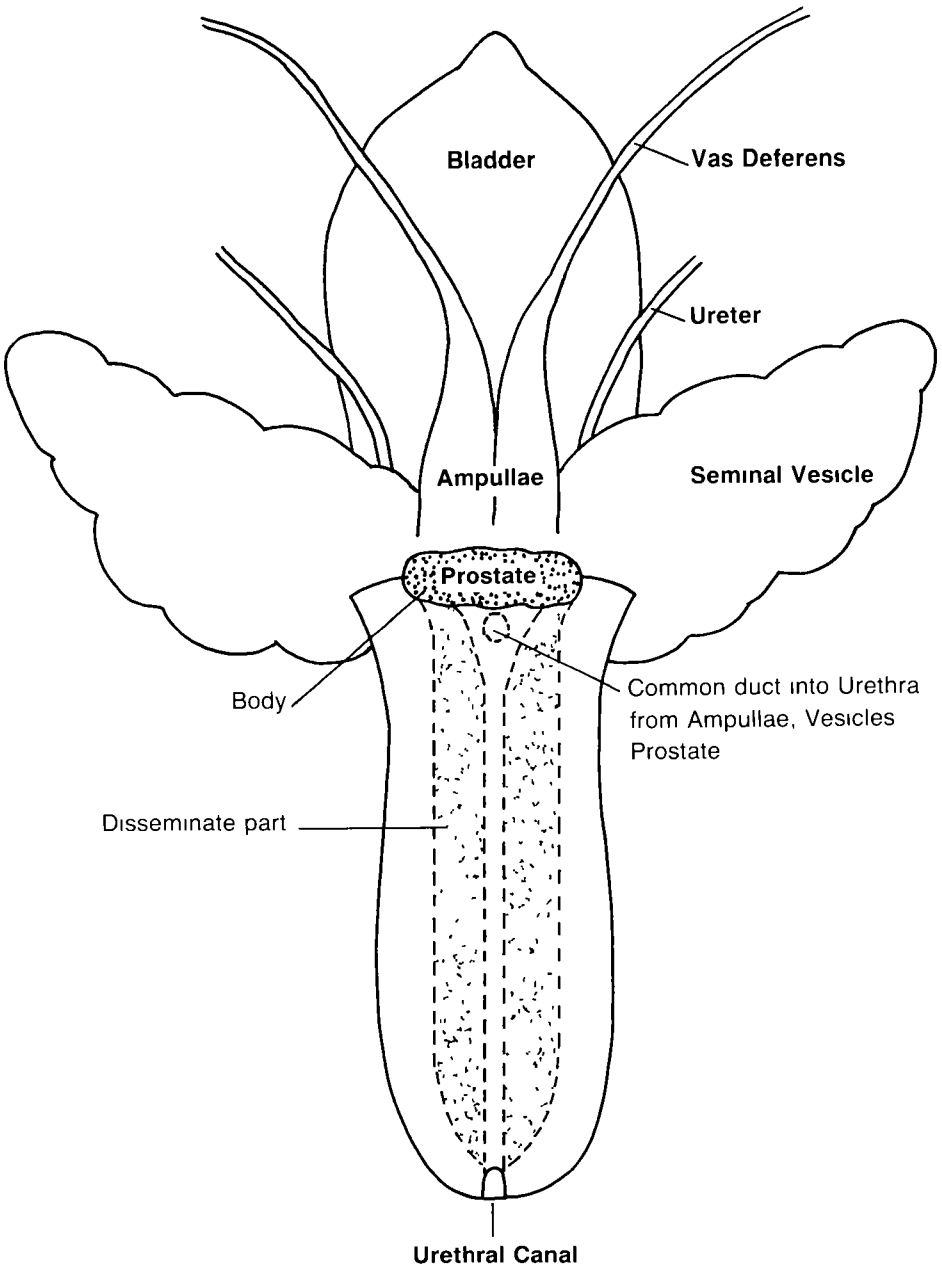

Fig. 1. Accessory sex glands of the red deer stag.

It is likely that during ejaculation the secretions from the prostrate, ampullae and vesicular glands are released into the uretha almost simultaneously, but nonetheless sequentially. Wallace and Birtles (1985) also proposed that during the pre-ejaculatory phase the bulbourethral glands release mucus which lines the urethra.

The epididymes and testes of the red stag also show marked seasonal variation in weight and histology, with weight peaking just prior to the rut (Lincoln 1971). Working with wapiti in Canada, Haigh *et al.* (1984) also recorded maximal values for scrotal circumference and serum testosterone concentrations about the time of the rut.

PUBERTY

Puberty in red deer stags is a continuous process which begins during the first autumn of life at about 3 months of age, but is more determined by the animals body weight than the daylength. A conspicuous delay in pubertal development occurs when the stag grows his first spike antlers in velvet but resumes as this ceases. The stags are fertile at 15 months of age, but may be too behaviourly naive to effect capulation at that age.

PHOTOPERIOD AND SEASONALITY

In the stag, the antler and sexual cycles are closely linked. When testosterone falls to very low levels in the spring the old antlers are cast. Velvet antler growth then occurs during a period when testosterone secretion is very low. As testosterone secretion from the testes increases in late summer/early autumn, the antlers are cleaned of velvet so that the stag is in the hard antler for the rut. Peak levels of testosterone occur at the time of the rut in autumn. About this time, the testes exhibit their maximum response to luteinising hormone (LH) (Fennessy and Suttie 1985; Suttie *et al.* unpublished). In contrast, there is virtually no testicular response in terms of testosterone secretion at casting or during early antler growth (Table 1).

TABLE 1. Plasma concentrations of LH and testosterone in red stags at various stages of the antler cycle[1].

Mean date	Mean weight	Antler status	LH (ng/ml plasma)	Testosterone
14 Jul	132	Hard	0.29	0.8
5 Oct	135	Casting	0.38	0.1
3 Dec	146	Mid velvet	7.1	0.3
12 Jan	160	Full velvet	7.5	1.2
9 Feb	166	Just cleaned	2.5	3.9
1 Apr	158	Hard : rut	0.43	12.1
14 Jun	147	Hard : post-rut	0.36	3.2
LSD (P=0.05)[2]			2.2	5.7

[1] Stags aged 2.5 years at start of experiment; the stags were sampled while under xylazine anaesthesia; the values are means for 8 animals.

[2] Least significant difference within columns.

A simplified description of the regulation of the sexual cycle under the control of the hypothalamic-pituitary-testicular axis is outlined in Fig. 2. In essence, the principles of regulation are similar to those operating in the female.

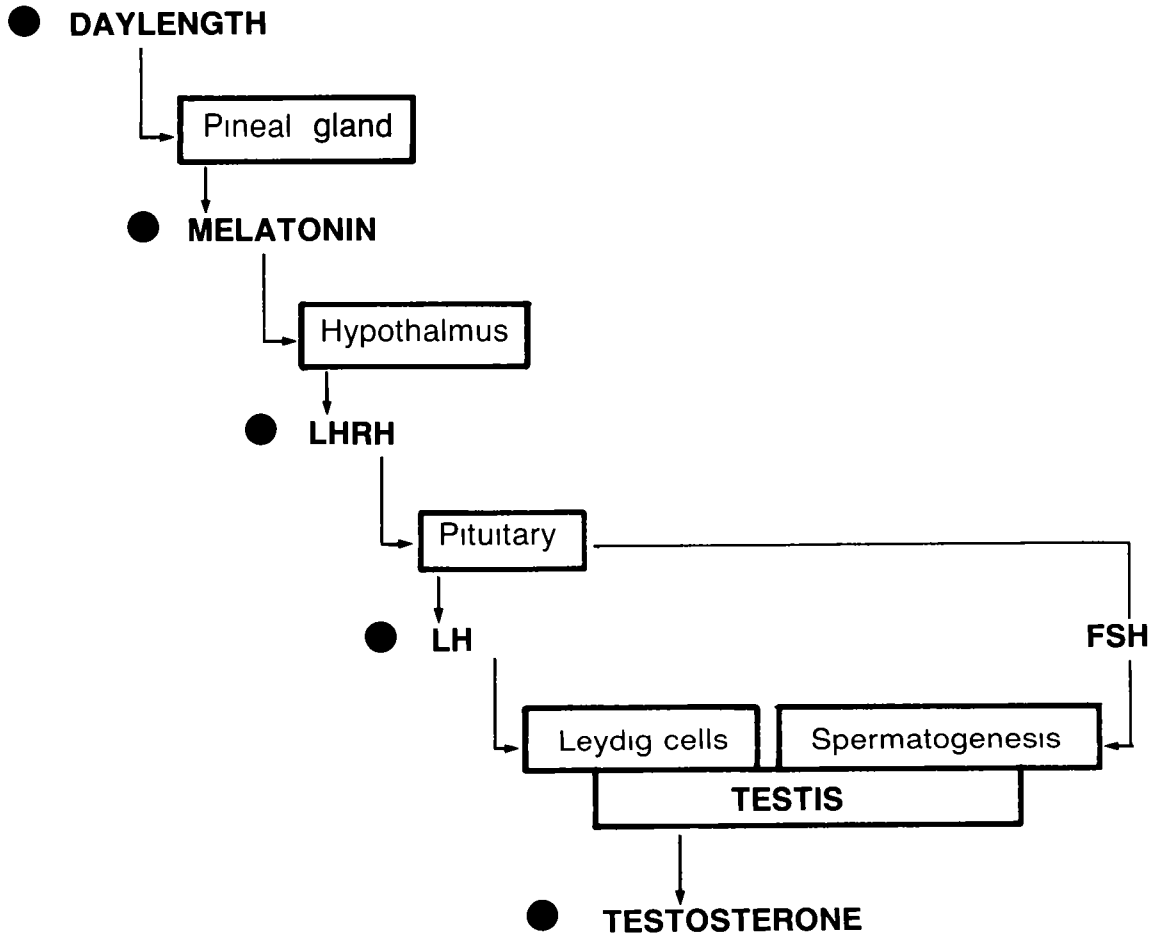

Fig. 2. Simplified description of the endocrine regulation in the male red deer.

Several studies have shown that it is the change in daylength, specifically a decline in daylength, which operates as the cue to stimulate testicular development. For example, stags under artificial photoperiods with alternate 2 monthly periods of 16 hours light: 8 hours dark (16L/8D) and 8L/16D exhibit cyclical changes in testis diameter antler status and feed intake with a lag period of about 8 weeks after the daylength change (Suttie *et al* 1984). Similarly, an implant of melatonin has proved effective in inducing premature testicular development about 6 weeks earlier than controls, when the stags were treated about one month prior to the summer solstice

(Lincoln *et al* 1984). The melatonin effect is dependent on LHRH secretion since any melatonin effect was blocked by active immunisation against LHRH.

SPERMATOGENESIS

Spermatogenesis is discussed in more detail by Haigh (1985, this volume). However, a few comments are necessary here. According to Lincoln (1971), spermatozoa were concentrated in large quantities in the epididymis from August till March (corresponding to February to September in New Zealand) with May and June (November and December in New Zealand) being the only months in which the epididymis was devoid of spermatozoa. However, the presence of oestrous hinds can induce mounting and mating behaviour by stags at any time of the year, even when the stags are growing velvet antler, although at this time fertilisation is impossible since stags are either aspermic or have a very high proportion of abnormal sperm (Jaczewski *et al*. 1984).

HORMONES AND BEHAVIOUR

In discussing the effects of hormones on behaviour it is necessary to differentiate between sexual and social (or hierarchical) behaviour within the herd. Sexual behaviour in the male involves roaring, flehmen, fighting with other stags for harem control, herding of hinds, smelling of hinds, etc. By social or hierarchicial behaviour is meant that within the bachelor herd when the males are together at times other than the autumn rut. Social hierarchy is determined largely by body weight and condition and the presence of hard antlers. Thus in the early spring, a relatively small stag which is still in hard antlers could have a relatively high position in the hierarchy compared with its position during winter when all stags were in hard antler.

Castration of adult stags will abolish virtually all sexual behaviour; implants of either testosterone or oestradiol will then restore sexual behaviour but only in the autumn (Lincoln *et al* 1972). Testosterone will increase social aggression at any time of the year in stags but oestradiol does not have this effect. Therefore, it is apparent that the effects of steroids on behaviour are somewhat complex and in the entire stag involve both testosterone and its metabolites.

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