Induction of testicular growth and sexual activity in rams by a 'skeleton' short-day photoperiod

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Summary. Eight adult rams were housed in 16L:8D for 16 weeks and then exposed to short days (8L:16D) or 'skeleton' short days (11L:1D:5L:7D) for 16 weeks before being returned to long days. The 'skeleton' treatment promoted testicular development and regression in a way similar to that occurring in 8L:16D, indicating that a change in the total quantity of light is not a prerequisite for the photoperiodic response in the ram.

Introduction

It has been shown for Soay rams that an abrupt change from long days (16 h light:8 h darkness, 16L:8D) to short days (8L:16D) induces gonadotrophin secretion, testicular development and full sexual redevelopment, while an abrupt change in the other direction reverses these effects (Lincoln, Peet & Cunningham, 1977; Lincoln & Davidson, 1977). The purpose of the present study was to establish whether these reproductive changes could be induced by a photoperiodic change which did not involve an alteration in the total amount of light or darkness in the 24 hours.

Methods

Eight adult Soay rams were housed in a light-proof building as described previously (Lincoln et al., 1977) and provided with artificial illumination of 140–180 lx at floor level. Weekly measurements were made of the diameter of the testes palpated through the scrotum and of the intensity of the 'sexual flush' on the inside of the hind legs (arbitrary scale 0–5). A continual index was kept of the aggressive behaviour of the rams by means of a mechanical device (Lincoln & Davidson, 1977).

Results

Short-day experiment (control). For a 2 year period the rams were exposed to alternating 16-week periods of long days (16L:8D) and short days (8L:16D); at the end of each period the light was abruptly changed by altering the time of 'lights out' by 8 h. The influence of these photoperiodic changes on the sexual development of the rams for the final complete light cycle is summarized in Text-fig. 1. The change from long to short days induced testicular growth and the appearance of the sexual flush in the rams, while the change from short to long days reversed these effects. Aggressive behaviour of the rams began to increase under short days when the testes were fully active and this behavioural change continued well into the period of long days.

Skeleton short-day experiment. At the end of the 2 year study and after a 16-week period of 16L:8D, the rams were exposed to 16 weeks of 'skeleton' short days, involving a lighting regimen for each day of 11L:1D:5L:7D, and then returned to long days (16L:8D). 'Lights on' for the principal light period was at the same time throughout. Under these conditions testicular growth, the appearance of the sexual flush and the development of intense aggressive behaviour occurred in the rams in a way similar to that observed in the short-day experiment, although the timing of the peak response for each indicator was delayed (Text-fig. 1). Transfer from 'skeleton' short days to long days resulted in regression of reproductive activity within 12 weeks.
Text-fig. 1. Weekly measurements of size of the testes (mean ± s.e.m.) and intensity of the sexual flush (scale 0–5 for each ram, indicated by the S number) in 8 Soay rams exposed to artificial photoperiods. (a) Short-day experiment: 16 weeks of long days (16L:8D) followed by 16 weeks of short days (8L:16D) and then a return to long days. (b) 'Skeleton' short-day experiment: 16 weeks of long days (16L:8D) followed by 16 weeks of 'skeleton' short days (11L:1D:5L:7D) and then a return to long days.

Discussion

While short-day photoperiods act as a stimulus to reproductive development in the ram, resurgence of testicular activity will occur spontaneously if animals are maintained for prolonged periods under long days (Lincoln & Davidson, 1977). The testicular development described in the present study involving the 'skeleton' short day could therefore be spontaneous rather than be induced by the light change. While this can explain the reproductive response, it is apparent that the rams were influenced by the photoperiodic change because they subsequently showed testicular involution under long days and remained relatively synchronized in the timing of their sexual cycles. This photoperiodic response was similar, although delayed, to that achieved by the change from long to 'normal' short days (8L:16D), in spite of the fact that the photoperiodic change in the 'skeleton' short-day experiment involved no alteration in the total amount of light or darkness during the 24 hours.

The 'skeleton' short-day treatment was adopted on the assumption that sheep have a 24-h rhythm in photosensitivity, as occurs in many plants, insects and birds (Follett, 1973). Soay sheep...
originate from northern latitudes where the length of daylight varies between approximately 7 and 17 h, and if the sensitive phase occurs relative to a dawn signal, then it might be expected to occur between 7 and 17 h after dawn. In the present experiment the 1 h dark period was placed 11 h after the dawn signal to fall within this predicted sensitive period. It has not been possible to do a series of parallel light-interruption experiments to establish whether there is a discrete sensitive period in Soay rams. The existence of such a period is strongly suggested by the work of Garnier, Ortavant, Mansard & Terqui (1977) who have shown, by using a light pulse to interrupt the dark phase, that the response of the ram to light varies throughout the 24 hours. It still remains to be established whether it is light or darkness during the sensitive phase which provides the photoperiodic response in the ram.

References


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