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The Basenji Annual Estrus: Controlled by Short-day photoperiod

by James E. Johannes

Introduction

Man from the earliest time has observed biological cycles in animals. The daily light cycle and the change in the length of day control these cycles. For birds the increasing day length (long-day photoperiod) begins the process of migration and mating. In mammals the reproduction cycle can be activated by the long-day or short-day photoperiod. Domestic animals have shown a trend in not needing the photoperiod to regulate the reproduction cycle and for breeding anytime during the year (Lofts, 1978). The Basenji is an exception.

Short-day photoperiod in the Basenji

The regularity of the Basenji estrus suggested to Fuller (1956) that it was probably controlled by the changing length of day. The timing of estrus in the fall also suggested that decreasing daylight triggered the estrus cycle. In order to test this hypothesis he carried out an experiment at the Bar Harbor Laboratory using three Basenji females. The females were kept indoors where a timer controlled a light. Commencement of the experiment was February. Occurrence of estrus was 104, 107 and 111 days after the start of light reduction. After successful mating in July normal puppies were produced. Fuller was able to conclude that decreasing day length (short-day photoperiod) controls the Basenji annual estrus.

Comparison to other canids

Most wolves have an estrus cycle that is controlled by the long-day photoperiod (Johannes, 2003). Many wild mammalian species at higher latitudes breed in response to increasing daylight (Lofts, 1970). At lower latitudes the Indian wolf and dogs who have a seasonal, annual estrus are apparently controlled by short-day photoperiod (Johannes, 2003). Mech (2002) has observed that the wolf's breeding date is related to latitude. For each 10° increase in latitude, the breeding season shifts later by 22 days. Wolves moved from Canada to Yellowstone National Park shifted their breeding season. This shift in the breeding season has not been observed in the Basenji. It is possible that changing from a short-day to long-day photoperiod is not possible or takes generations. Even though the Basenji now lives at higher latitudes it continues to exhibit an estrus cycle for lower latitudes.

Northern and Southern Hemisphere

The earth's tilt on its axis causes the northern and southern hemisphere to have opposite seasons. Because the Basenji's estrus cycle is controlled by the photoperiod, it is possible for the estrus cycle to shift immediately to the correct season when a Basenji moves from one hemisphere to the other.

Biological Process

The process controlling the photoperiod is for the most part known. There are three major components, the retina, pineal gland, and hypothalamic-pituitary (see figure 1).

The retina not only provides vision but is also used by the body as a means to measure the length of day and night. The SCN (Suprachiasmatic nucleus) uses the light impulses from the retina to set itself. It regulates the bodies circadian (daily) cycle, including regulating the pineal gland to secrete melatonin during the night. The circadian rhythm of melatonin codes the circannual (yearly) cycle of seasonal reproduction.

For short day breeders, such as the Basenji, melatonin is high during the breeding season and is stimulatory to gonadal function. Increasing amounts of melatonin eventually trigger the hypothalamus and pituitary gland to stimulate the ovaries to produce estrogen. The opposite occurs for long day breeders.

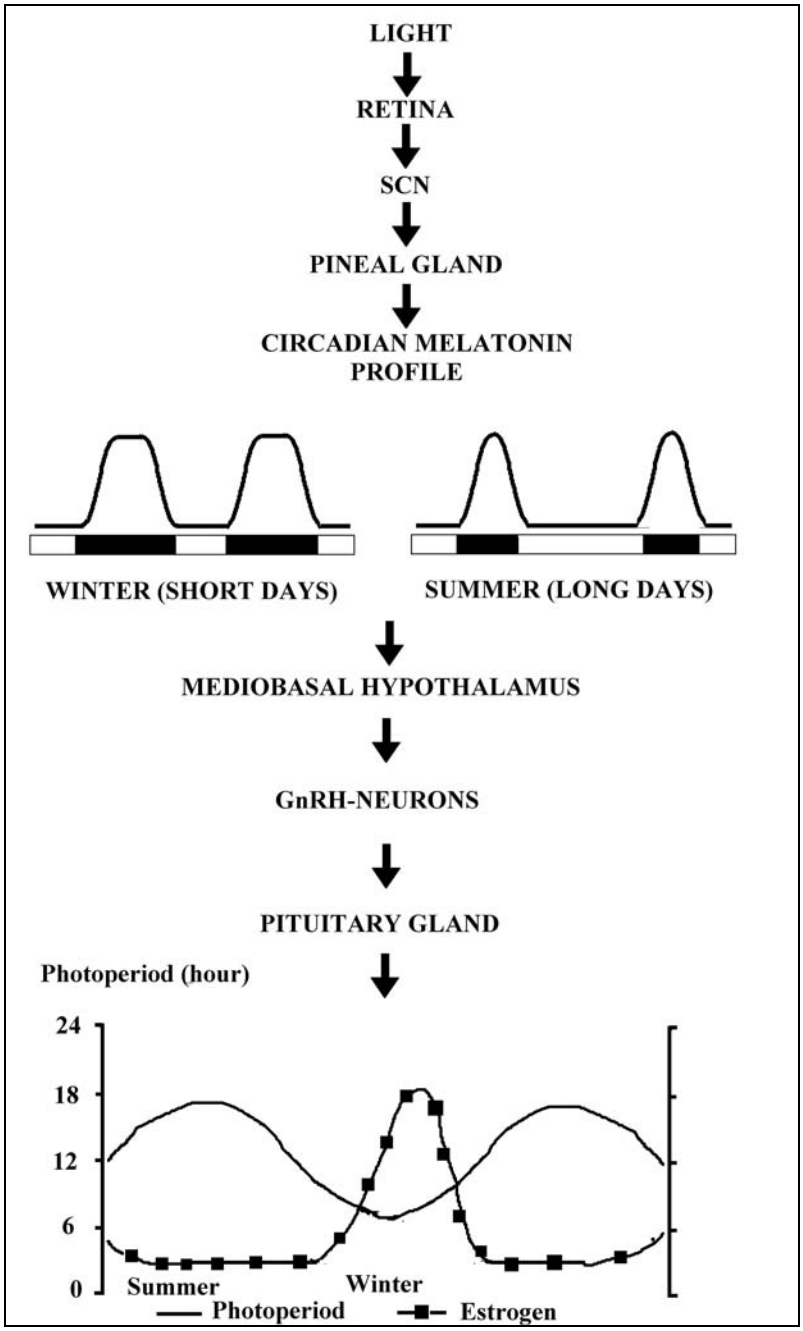

FIGURE 1. Schematic drawing of the retinal-pineal-hypothalamic pathway. (Sources: Andersson, 2000, Arendt, 1998 & Shiu et al., 1998)

Photoperiod in the male Basenji

The females are not alone in having a season. Wallis (2003) wrote in a recent article that two Basenji males living miles from any other Basenji exhibit aggression and stress for two months during the mating season. Apparently, Basenji males have a season and it is most likely controlled by the photoperiod.

Loss of the photoperiod in domestic dogs

It has been observed that the domestication of animals causes similar changes in morphology and physiology (Crockford, 2000). One of these changes is in reproductive timing or shifts in its seasonal occurrence. Domestic animals show a trend in loss of dependence on photoperiodism. This loss has generally occurred in the dog.

For 40 years Dr. Dmitry K. Belyaev in Siberia transformed the Silver Fox into a dog-like creature by selecting for tameness alone. One of the results was a diestrous (two) heat cycle. Wild Silver Foxes have one seasonal estrus in a year (Trut, 1999). It is believed that a change in docility and lessened fearfulness changed production of thyroxine in the Thyroid Gland (Crockford, 2000). This hormone is important in the development and function of the gonads. The manufacture of thyroxine by the Thyroid is due to the stimulation by the pineal, hypothalamus and pituitary glands. Thyroxine will vary throughout the day and

shows distinct patterns due to season. Differences in thyroxine (T_4) levels between breeds have been documented. It has been noted that Basenjis have a more active thyroid than other breeds (Coe, 1990). Whether this increased activity is reflection of the Basenjis use of the photoperiod and seasonal estrus is hard to say.

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