PART 2

Solving The Riddle Of Deer Movement

Nobody can hope to predict whitetail activity patterns without first understanding the many natural cycles that dominate the lives of bucks and does.

by Dr. James C. Kroll & Ben Koerth

With so much attention these days being focused on ecological and environmental issues, it is hardly surprising that the public has recently become intrigued with what is often termed "the circle of life." Many people have long assumed that life is simply a straight line from start to finish, but there now seems to be a clearer understanding that everything in the natural world is really part of one cycle or another.

Ecologists and animal scientists have understood the concept of natural cycles for many decades, however, and those of us whose professional work centers on the study of white-tailed deer are as aware of them as anyone else. A whitetail's life is nothing more than a series of repetitive cycles: feeding and breeding, along with nursing young (females) or growing antlers (males). So, understanding these cycles is crucial to understanding factors that influence *what* a deer is doing, *when* the deer will do it and *why*. Here, we will explain the various whitetail cycles and discuss what effect(s) they have on deer activity and movement.

THE NUTRITIONAL CYCLE

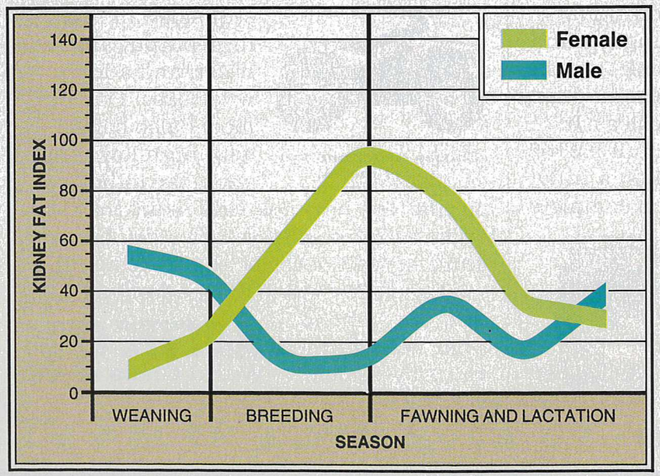
In modern society, "being fat" means something entirely different for humans than it does for other animals. We humans all want to be slim and trim, so we can give our best impression at the beach or on the golf course. Yet for deer and other wild animals, being thin is hardly helpful in dealing with day-to-day struggles. A thin animal has few reserves for bad times and soon will die or at least suffer reduced reproductive capacity.

A fat animal, on the other hand, is a healthy animal, especially during colder times of the year. So, how much fat a whitetail stores and how long it takes to accumulate that stockpile of reserves not only influence survival and reproduction, they also determine how active a deer must be in order to achieve or maintain adequate nutritional levels.

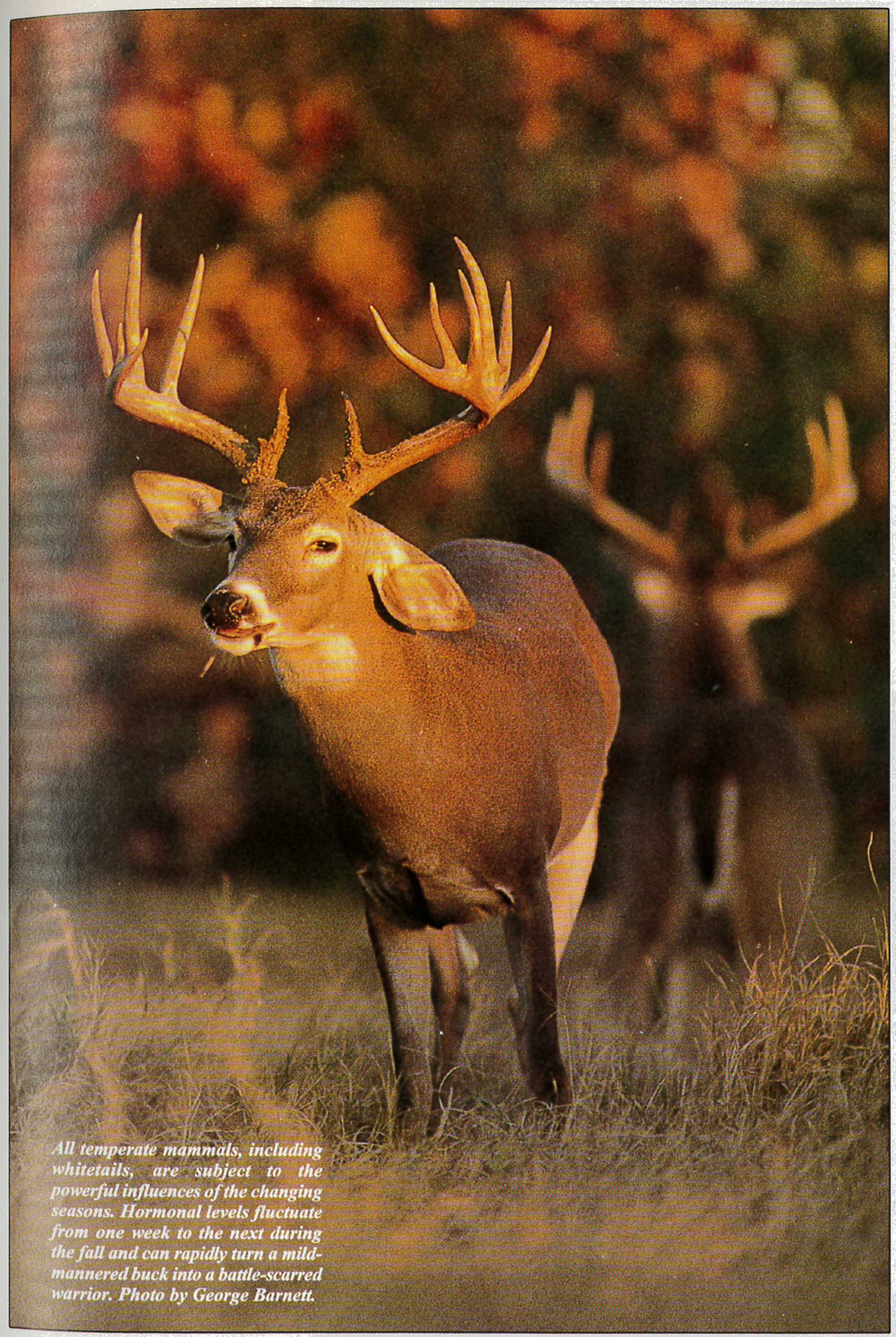
In addition, demand for certain nutrients changes over time in accordance with demands being placed on the deer's body. In spring and summer, when does are nursing their fawns and when bucks are growing antlers, high-protein foods are important; conversely, in fall and winter, whitetails depend more heavily on high-energy foods.

Much research has been done to compare the nutritional needs of whitetails by age and sex. The nutritional demand on a doe during the time she is carrying developing fetuses is much different from that for a buck, which has no such reproductive burden. But only a few months later, the buck becomes quite active during the rut, experiencing stress at a time when does undergo little, if any, physiological stress. The annual fat cycle thus is quite different for the two sexes. (See graph.)

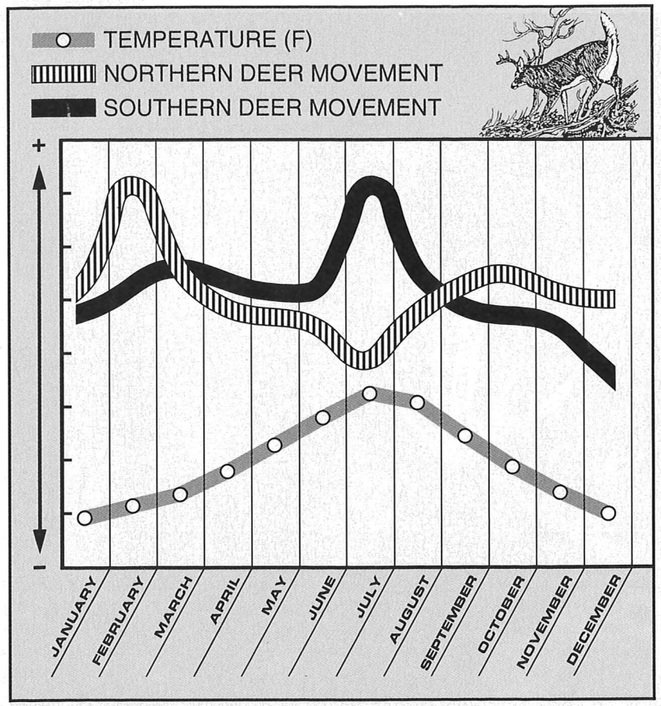
Does tend to have a rough go of it during the time of lactation (milk



Researchers use the "kidney fat index," which is a measurement of body fat, to quantify a deer's physical condition. This graph shows the normal seasonal fluctuation of kidney fat in white-tailed deer, indicating that bucks and does have markedly different stress periods. Graphic by Allen Hansen.

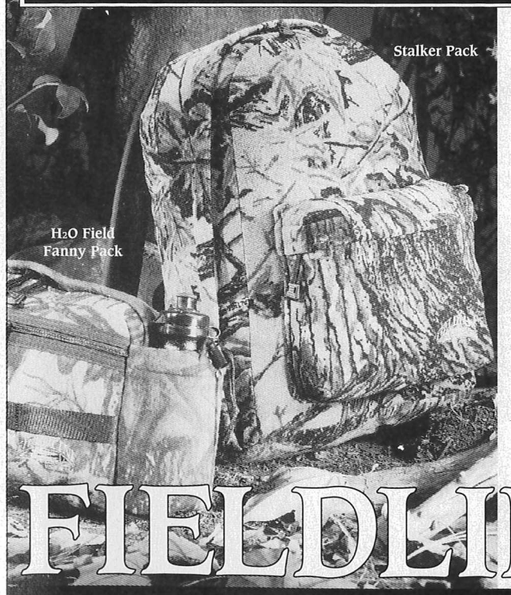


All temperate mammals, including whitetails, are subject to the powerful influences of the changing seasons. Hormonal levels fluctuate from one week to the next during the fall and can rapidly turn a mild-mannered buck into a battle-scarred warrior. Photo by George Barnett.



In studies of radio-collared deer, Darrell Evans found definite differences in Northern- and Southern-herd seasonal movement. Graphic by Allen Hansen.

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production), while bucks' kidney-fat stores remain higher during this period. After fawns are weaned, does rapidly accumulate fat, largely through increased consumption of such high-fat and high-carbohydrate foods as acorns, agricultural crops and soft fruits.

Again, while summer is a relaxed time for bucks, the onset of fall brings quite different conditions. Bucks significantly reduce their food intake as the rut cycle commences, and they can quickly lose as much as 40 percent of their body weight. Food is a low priority, and the little feeding they do occurs "on the run."

Due to these differing cycles, bucks come out of the rut in poor condition, while does (given the availability of adequate nutrition) emerge in very good shape. So, the two sexes have entirely different nutritional requirements for much of the year. In fact, we biologists have, for all practical purposes, come to view bucks and does as separate "species," due to widely differing nutritional cycles and distinct behavioral patterns. For a large portion of the year, the lives of bucks and does rarely overlap.

THE REPRODUCTIVE CYCLE

Numerous studies on various species of non-tropical mammals all come to one basic conclusion: the number of hours of sunlight versus darkness in a 24-hour period has a significant effect on the timing of breeding. Tropical species normally do not have the luxury of definable cues to time their breeding, because the number of hours of light versus dark in the tropics varies little throughout the year. In many cases, then, tropical mammals' breeding cycles are controlled primarily by wet and dry seasons.

In either case, however, the goal is to produce offspring at a time of year when food is abundant. The growth of a fetus can be compared to that of a bank account for which interest is being compounded: For a lengthy period, there is little growth, and then this period is followed by a rapid increase. Whitetail fetuses grow relatively slowly during the first half of the gestation period, but there is a rapid increase in size from then on.

This places a very high nutritional demand on the doe, because she is the one responsible for acquiring

food for both the fetus(es) and herself. So, does' food demands and intake go way up during late spring and early summer in areas that have a midfall breeding period.

If we backdate from a normal spring fawning time the appropriate gestation period (approximately 190 days), we see that the doe has to come into breeding condition sometime in the fall. How does she manage to time all of this properly?

Two types of factors — innate and environmental — regulate breeding in does. It has been demonstrated that over the short haul, whitetails have a certain "built-in" ability to cycle properly, even without environmental cues. However, it also has been demonstrated that in the continued absence of such cues, cycling begins to drift away from the optimum breeding time. So, it appears that an "internal clock" in every deer — buck or doe — regulates the basic timing of breeding.

This "clock" could be genetically linked, based on research by Dr. Harry Jacobson of Mississippi State University. He found that when he crossbred northern races of whitetails (midfall breeders) with whitetails from Mississippi (midwinter breeders), the offspring displayed an intermediate breeding season. This study was significant in that, for the first time, the scientific community had evidence that each race or local group of deer might have a unique rut timing that allows for fawning at the time when environmental conditions in that area are most appropriate.

That leaves us with trying to understand how a whitetail "knows" the best time to breed. There clearly is a link between night length and reproductive cycles in the North American herd. But what actually regulates this mechanism?

Research has revealed the existence of a chemical called melatonin, produced in the vestigial "third eye," or pineal gland, of mammals. (You might have heard of melatonin, because it recently has been widely promoted as a sleep enhancer for humans.) How this chemical works is interesting. Although you commonly hear people refer to "day length" as the key to the timing of animal cycles, it actually is the length of the *night* that regulates such cycles. In the absence of light stimulation, the pineal gland manufactures melatonin, which provides the brain with a way to measure day length. The amount of melatonin in the blood is directly correlated to the length of the night.

A second anatomical structure, the hypothalamus, then reads the level of melatonin in the bloodstream. At the proper level, the hypothalamus releases various hormones, including luteinizing hormone releasing hormone (LHRH). Once LHRH is in the bloodstream, it causes the brain's pituitary gland to secrete the appropriate sex hormone: luteinizing hormone (LH) or follicle stimulating hormone (FSH). These chemicals control everything from ovulation and sperm production to the development of such secondary sex characteristics as antlers.

Experimental studies on whitetails in controlled-light environments have shown that the animals can be "tricked" into producing more than one set of antlers or even into ovulating several times during a single year. So, we must conclude — given that the reproductive season is genetically determined — that the actual triggering of breeding must be by day (make that night) length.

But what happens if a doe is not bred at the perfect time? Will she then just miss breeding that year? No. Nature long ago took into account the possibility of some minor miscue. In such cases, it is the normal, repetitive cycling of the doe's reproductive system that allows for a longer window of opportunity to breed.

In most cases, the doe actually begins cycling before bucks are ready to breed. In fact, a doe can cycle through estrus up to seven times in a single year if she is not bred. That means *the buck, rather than the doe, probably pinpoints the exact timing of conception.*

The normal estrous cycle of a doe takes 25 to 27 days, rather than the 28 days many people believe. Later in this series, we will show exactly how the lunar month is tied to this and how it impacts deer activity.

THE ANTLER CYCLE

In a very real sense, whitetail bucks must undergo puberty every year. Can you imagine the trauma that creates? The same system that permits the female to begin her

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estrous cycle also allows the male to initiate and complete antler growth.

The buck's pineal gland continues to measure night length by gauging the production of varying amounts of melatonin in the bloodstream. As nights get progressively shorter, the hormonal "faucet" for testosterone production is turned off. This sets into play a host of phenomena, including antler casting, shedding of the winter coat and the start of velvet antler growth — once again, a cycle.

Anthony Bubenik and his son, George, of the University of Guelph in Ontario, pioneered much of our current knowledge of how deer antlers grow, and they put forth the idea that testosterone is not the only hormone playing a role in this process. Regardless of how many hormones are involved, the point is that for both sexes these mechanisms are cyclic, being regulated by night length. The buck's brain, like the doe's, monitors melatonin levels and responds with the appropriate hormonal action.

Whether the discussion concerns antlerogenesis or the estrous cycle, we must make one key point, the importance of which will become crystal clear later in this series: An animal's body is regulated both neurologically and hormonally. In the case of nerve-directed responses, the body responds almost immediately to stimulation. For example, you burn your finger, and there follows an almost immediate, involuntary withdrawal of your hand from the offending heat. The release of a hormone, on the other hand, does *not* elicit an immediate response; rather, there is a lag time.

This point about hormones is so crucial to understanding deer activity that its importance can hardly be overstated. The environmental cue that produced the specific whitetail behavior or activity pattern we see today might actually have occurred a good bit earlier. As we get farther into this analysis of deer movement, we'll show you exactly what that means from a hunter's perspective.

ENDOGENOUS ACTIVITY

Darrell Evans, a graduate student at the Institute for White-tailed Deer Management and Research, conducted experiments in hopes of determining whether or not whitetails have a built-in "clock" that determines activity patterns. Such cycles, called *circadian rhythms*, have been discussed by biologists for many years.

Using years of data from radio-collared wild deer to show the timing of movement, Darrell tested an old theory that the activity pattern for whitetails can be charted as a sine wave. (See graph.) Peak activity in most cases occurs after dark, with minimal movement occurring during daylight hours. In other words, as most hunters would suspect, whitetails are largely nocturnal, or at least low-light, animals.

But Darrell's research pointed out some interesting regional variations. Analysis of the data showed that although both northern and southern deer show cyclic daily movement patterns, the two broad groups often have different *seasonal* patterns. Movements are shortest for northern deer in winter, while minimal movement of southern deer occurs in summer. The primary factor explaining these differences appears to be air temperature — another important point we will explore later in this series.

The upshot of years of research is that we now know deer activity patterns are to a great extent controlled by an "internal clock" that is in turn triggered by external factors. We also know that while the timing of breeding is controlled internally, the deer's physiological and behavioral changes are triggered by environmental cues.

The rut is obviously one of the most important factors affecting movement during the fall, especially for bucks. But what do we scientists really know about the rut, and how do we know it? Next month, we will examine whitetail breeding activity in more detail, to show how research is unraveling the secrets of this frenzied part of the deer's year.



FOR YOUR INFORMATION

The Institute for White-tailed Deer Management and Research, founded by Dr. James C. Kroll, is currently working with ***WHITETAIL*** to produce a book on predicting deer movement. The book is scheduled for fall release. For more information on the Institute, contact: College of Forestry, Box 6109, Dept. WT, SFA Station, Nacogdoches, TX 75962. Phone: (409) 468-2004.