

# WHITE-TAILED DEER

By Chuck Fergus and Bill Shope

Division of Information and Education  
Pennsylvania Game Commission

The white-tailed deer, *Odocoileus virginianus*, derives its common name from the fact that the underside of its tail is covered with white hair, and when it runs it often holds its tail erect so that the white undersurface is visible. Whitetails belong to the Cervidae family which in North America includes the elk, moose, caribou, and mule deer. Cervids are split-hoofed mammals with no incisor teeth in the front of the upper jaw. They are classed as ruminant animals, meaning they have a four-chambered stomach and frequently chew a "cud." Adult male cervids grow and shed a set of antlers each year. Most female caribou also grow antlers, and an occasional antlered doe occurs in whitetails.

Scientists have identified thirty subspecies of whitetails in Central and North America. Whitetails occur from southern Canada south through the United States and Mexico to Panama, but they are absent from most of Canada, Nevada, and Utah. They occur commonly throughout Pennsylvania.

The largest of the subspecies is the northern woodland whitetail, and the smallest is the endangered Florida Key deer. The subspecies occurring throughout most of Pennsylvania is the Virginia whitetail, which is slightly smaller than the northern woodland whitetail.

In Pennsylvania the average adult male buck weighs about 140 pounds live weight and stands 32 to 34 inches at the shoulder. He is about 70 inches long from the tip of his nose to the base of his tail. His tail vertebrae add only about 11 inches, but the long hair makes it far more conspicuous. Does tend to average less in weight and body length than males of the same age from the same area.

Deer weights vary considerably, depending upon age, sex, diet, and the time of year the weight is checked. For example, breeding-age bucks may weigh 25 to 30 percent more at the onset of the breeding season than they do at its conclusion. Hence, a 140-pound buck in December might have weighed approximately 180 pounds in September.

Hair color is alike in both sexes. In adults the belly, throat, areas around the eyes, insides of the ears, and the underside of the tail are white all year long. In summer the upper parts of the body are reddish brown, and in winter they are grayish brown.



Summer hairs are short, thin, straight, and wiry. Winter hairs are long, thick, hollow, and slightly crinkled. Winter hairs afford the deer excellent protection against the cold. Summer coats are shed in August and September, winter coats in May and June.

Melanistic and albino deer occur but they are rare. Partial albinos, sometimes called "piebalds" or "calico" deer, occur more frequently.

Fawns are born with white spots in the upper coat. When a fawn is lying on the ground or in dry leaves, this coat looks like the sun hitting the ground after it passes through the treetops. This provides excellent camouflage for the fawns. Their summer coats are molted about the same time as the fall molt in adults, and fawns take on the same coat colors as adults in the fall.

Whitetails have scent-producing glands: two tarsals, one

inside each hind leg at the hock joint; two metatarsals, one on the outside of each hind leg between the hock and the foot; and four interdigitals, one between the toes of each foot. The tarsals and metatarsals release scents conveying excitement or fear, while the interdigitals produce odors which let deer trail each other by smell.

Deer can run at 40 miles per hour for short bursts and maintain speeds of 25 miles per hour for longer periods. They are also good jumpers capable of clearing obstacles up to 9 feet high or 25 feet wide. The air-filled hairs of their coats enable them to swim easily.

Although whitetails are color-blind and have a hard time identifying stationary objects, they are easily alerted by movement. Nature has compensated for their poor vision with keen senses of smell and hearing which help them detect danger.

Usually deer are silent, but they can bleat, grunt, whine, and when alarmed or suspicious, make loud "whiew" sounds by forcefully blowing air from their nostrils. Does whine to call their fawns and fawns bleat to call their mothers.

Although antler growth is evident on male fawns, it is not prominent and is known as "buttons." A buck's first set of antlers begins to grow when he is about 10 months of age. Each year after he reaches this age, he will grow and shed a new set of antlers. Typical antlers curve upward and outward to point forward, and consist of two main beams with individual tines growing upward from them.

If the yearling buck comes from an area which has poor food conditions, his first set of antlers may be only "spikes" — antlers consisting of single main beams only. Spikes are more common in yearling deer than older ones because antler growth is slow at a time when the young buck's body is still growing rapidly. But because antler development is tied in closely with the animal's nutritional status, older bucks might also carry spikes if they come from an area with poor food conditions. More of the nutrients in the young buck's body are going for body growth than in older bucks, hence, less are available for antler development. Fifty percent or more of the yearling bucks from poor deer range in Pennsylvania may produce only spikes, compared to 10 percent or less from good deer range.

Antlers generally begin to grow in March or April. Growing antlers are covered by a skin called "velvet." This velvet is covered with soft hairs and contains blood vessels which supply nutrients to the growing antlers. The solid bone-like substance which makes up the polished antler is secreted by cells on the inside of the velvet. By August or early September

antler growth ceases and the velvet is shed or rubbed off by the buck as he rubs saplings, shrubs, or rocks with his antlers. Polished antlers are carried throughout most of the breeding season, which lasts into late February. The antlers are shed at the end of this period, and a new set begins to grow in March or April.

When antlers are growing they are soft and subject to injury. Bent and twisted tines and main beams are a result of injury to the antler while it was growing. Broken antlers occur after the antler has stopped growing and is hard. The small cavities sometimes seen in polished antlers are a result of botfly larvae damage during the growing period.

The antler cycle is influenced by secretions from the pituitary gland. Changes in length of daylight periods and, to a lesser degree, temperature influence the hormone secretions from this gland. The hormone prolactin is believed to be a factor in the initiation of new antler growth. Increases in the amount of the male hormone testosterone in the blood of whitetail bucks in late August and early September cause blood flow to the antlers to stop. The velvet dies and is shed or rubbed off. Throughout the breeding season, testosterone levels continue to increase until they hit a peak in November. This peak coincides with the peak breeding dates. Testosterone levels begin to fall after this, and when they reach a low enough level the antlers are shed.

In general, shedding of antlers occurs earlier in northern states than in southern ones. Spike bucks tend to retain their velvet longer and shed their antlers sooner than bucks with branched antlers. The roles of age and nutrition in the length of antler retention are not fully understood at present.

## SOCIAL ORGANIZATION

The social organization of the whitetail deer is largely matriarchal. Although large numbers of deer are sometimes seen together in feeding areas or wintering areas, these associations are usually temporary and do not reflect the same strong ties as family associations between related does. The most common social group is an adult doe, her fawns, and her yearling female offspring. Sometimes three or four generations of related does are present in a single family group. When the fawning season rolls around in late May, adult does leave the family group and remain alone to bear and rear their fawns. Once a pregnant doe leaves the family circle to bear her fawns, her yearling offspring are left on their own for the summer.

Siblings tend to remain together throughout most of the summer. Sibling groups which include yearling bucks separate in September as the rut approaches. Yearling bucks tend to disperse from the mother's home range at this time. Yearling does remain in the mother's home range and generally rejoin their mother and her new fawns between September and October.

During the breeding season adult and yearling bucks tend to stay alone except when in pursuit of a female who is approaching estrus. After the breeding season in late January, yearling and adult bucks form loose associations of small groups, usually 2 to 4 animals, which remain together throughout most of the winter and summer months. These groups break up around September when the rut starts.

## REPRODUCTION

The mating season of white-tailed deer begins in September and lasts into late January. Breeding activity reaches its peak in mid-November, and most adult females have been bred by the end of December.

Some female fawns achieve their first estrus at 7 or 8 months of age and produce their first fawns at 14 or 15 months of age.



Age Class	% of ♀ Breeding	Average No. Per ♀	Sex Ratio ♂ : ♀	FETUSES		
				% of Total ♀ Bred by No. Fetuses Carried		
				1	2	3
Fawn (6 mos.) .....	45	1.36	130:100	67	31	2
Yearling (18 mos.) .....	90	1.66	124:100	40	56	4
Adult (30+ mos.) .....	95	1.84	124:100	21	73	6

Most of these animals breed a month or two later than older does.

The age and nutritional level of the doe influence her reproductive capacity. Females from the best range produce more fawns than those from poor range. The number of fawns annually produced by females increases as their ages increase. There is also a pronounced tendency for young females to produce a larger percentage of male offspring than older does. The nearby table summarizes the average data for deer productivity in Pennsylvania.

### FOOD HABITS

Whitetails eat a wide variety of herbaceous and woody plants. In a recent study in Pennsylvania which involved the examination and measuring of the food contained in the rumens of vehicle-killed deer, 98 different plant species were identified. Fifty-seven were tree, shrub or vine species, and 41 were herbaceous plants. There were also a lot of unidentifiable plant materials, mostly herbaceous, which could easily extend the list beyond the 98 identified species.

Food preferences of whitetails depend on the plant species occurring in an area and on the time of year. Green leaves, herbaceous plants, and new growth on woody plants are eaten in the spring and summer. In late summer, fall, and early winter, both hard and soft fruits such as apples, pears, and acorns are a major component of the deer's diet. In winter, evergreen leaves, hard browse, and dry leaves are eaten. Good supplies of a variety of natural foods at all times of the year are essential to the survival and maintenance of a healthy deer population.

### HABITAT

A brush-stage forest satisfies two needs for deer: (1) concealment, and (2) food in the form of buds, stems and leaves of shrubs and young trees. Brush is most efficiently created by forest clearcutting. Clearcutting means cutting all trees larger than saplings, leaving an area of land looking "clear." Usually the most use of a clearcut area by deer occurs along its edges. Shaping a clearcut to give it the greatest edge effect will increase its value to deer.

Newly cut treetops provide an immediate source of browse in winter months when snow cover makes other sources of food

unavailable. Therefore, when possible, the actual cutting operations should be carried out when the trees are dormant. However, the greatest benefit of clearcutting to deer lies in the often abundant herbaceous vegetation, new succulent stump sprouts, root sprouts and seedlings, that flourish in the sunlight following the cutting. Once established, this new thick growth also provides concealment for deer, not only in the early years following the cutting, but for a longer period, after much of the browse has grown out of their reach.

While most deer habitat management should revolve around a forest cutting program, including the establishment of herbaceous openings, a conifer tree planting program to shelter deer in severe winter weather is sometimes necessary where suitable cover of that type is absent. The value of these plantations to deer is low during most of the year but high during winter. As with clearcutting, conifer plantations should be kept small and scattered. Large plantations are unnecessary. Small clumps of only 30 to 60 trees will suffice. Individual trees within the plantation can be spaced as far apart as eight to ten feet. Preferably, these clump plantings should be located in lowlands or on south-facing slopes.

### MANAGEMENT HERD (Population)

Deer are a valuable natural resource which can be maintained indefinitely where suitable habitat exists. If managed wisely, they are a valuable public asset. Economically, they generate significant revenues for many rural communities because they attract hunters and wildlife watchers. Public support of sound management programs is essential to maintaining the deer population as a public asset to be enjoyed by future generations of Pennsylvanians and visitors to Pennsylvania.

Management of the deer herd means controlling the size of the deer population. Population control can be achieved only by harvesting female deer. In Pennsylvania this is accomplished through regulated antlerless deer seasons. Restrictions on the number of deer a hunter may take, the number of persons hunting in a given county, and the length of the season are the methods used to control the antlerless harvest. The number of antlerless deer to be taken in any county is determined from the estimated deer population and the ability of the forest habitat to support that number during the winter.

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## Facts About Deer Antlers

The allure of antlers is one of the key reasons why people are so fascinated with deer. Antlers are a fascinating and unique type of animal tissue. They are found only in the family *Cervidae*, which in North America includes deer, elk, caribou and moose. Antler tissue is perhaps the most rapidly growing of all tissues; an elk can grow a complete set of antlers (about the weight of a human skeleton (45 pounds) in about 75 days.

Some people refer to antlers as “horns”, but the two are quite different. The table below highlights the differences.

<i>Antlers vs. Horns</i>		
<i>Characteristic</i>	<i>Antlers</i>	<i>Horns</i>
Tissue	Living tissue, true bone	Dead cells, hollow, composed of keratin
Growth Point	Tip	Base
Permanence	Deciduous (i.e., shed annually)	Permanent
Occurrence relative to sex of animal	Found only on males with exception of caribou	Found on both sexes

*Antler function:* Antlers seem to have evolved primarily as weapons for fighting to determine male dominance for breeding rights. It is not clear however whether antlers really are needed as weapons or merely as “display organs” serving a function similar to body size or color in other animals. Some scientists believe that antlers evolved as “thermal radiators” to allow heat dissipation during hot months, but if that was the case why don’t the does have antlers?

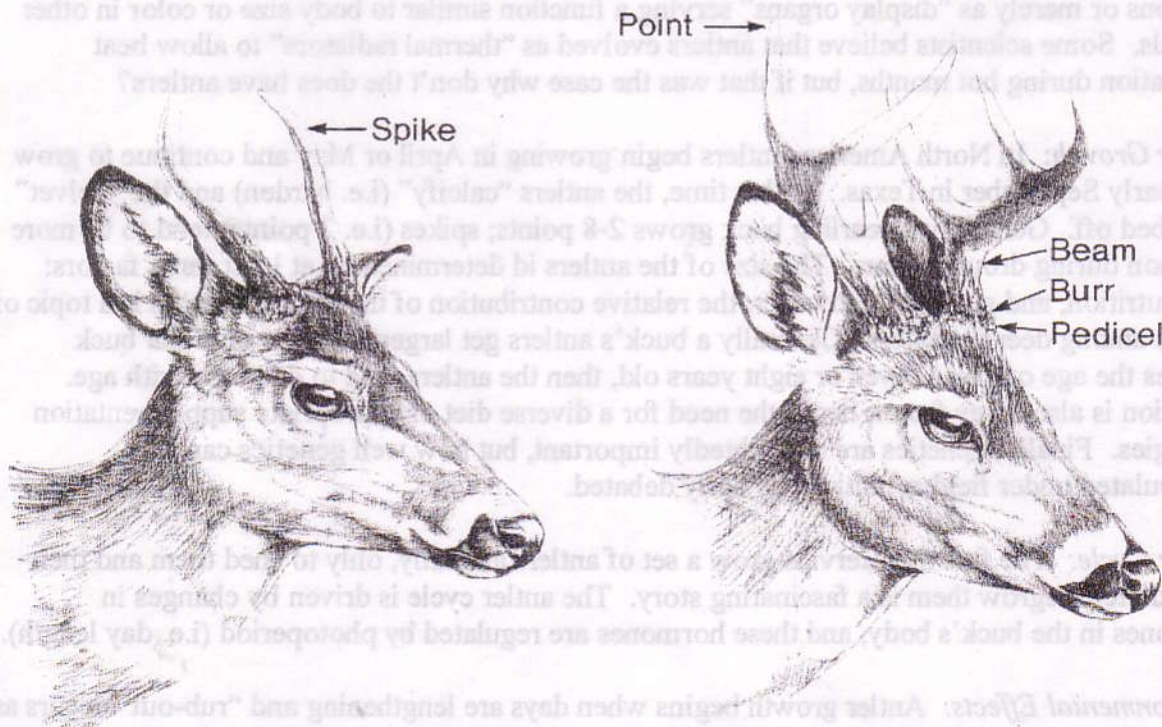
*Antler Growth:* In North America, antlers begin growing in April or May and continue to grow until early September in Texas. At that time, the antlers “calcify” (i.e. harden) and the “velvet” is rubbed off. Generally a yearling buck grows 2-8 points; spikes (i.e. 2 points) tend to be more common during drought years. The size of the antlers is determined by at least three factors: age, nutrition, and genetics. However, the relative contribution of these three factors is a topic of debate among deer managers. Generally a buck’s antlers get larger with age until the buck reaches the age of about seven or eight years old, then the antlers tend to decrease with age. Nutrition is also a key factor, hence the need for a diverse diet or appropriate supplementation strategies. Finally, genetics are undoubtedly important, but how well genetics can be manipulated under field conditions is hotly debated.

*Antler Cycle:* The fact that Cervids grow a set of antlers annually, only to shed them and then immediately regrow them is a fascinating story. The antler cycle is driven by changes in hormones in the buck’s body, and these hormones are regulated by photoperiod (i.e. day length).

*Environmental Effects:* Antler growth begins when days are lengthening and “rub-out” occurs as days are shortening. Temperature and rainfall have little impact on the timing of the antler cycle. By manipulating photoperiod under laboratory conditions, bucks can be “tricked” into growing more than one set of antlers (up to 3 sets annually). The farther deer are from the equator, the more defined is their antler cycle.

**Hormonal Control:** Like most body functions, various hormones are involved. Endocrine glands involved in the antler cycle include the pituitary (the “master gland of the body”), the pineal gland, and the testes. The male hormone testosterone is the primary hormone that controls antler growth. Castration of a buck affects antler development, but the effect changes with the age at which the buck was castrated. If castrated as a fawn, the buck never grows antlers. If castrated after its first set of antlers, the buck will grow another set of antlers, but will never shed them. In such bucks the antlers continue to grow more points and they are often referred to as “cactus bucks”. If a deer is castrated after his antlers have hardened, he will soon shed them and then grow velvet antlers the next season.

The pineal gland, a pea-sized endocrine gland at the base of the brain, plays an important role in the antler cycle. Sometimes referred to as the “third eye”, the pineal gland can sense changes in photoperiod, probably via the optic nerve. At the appropriate time, the pineal gland stimulates the pituitary gland (the master gland of the body) to produce luteinizing hormone (LH) which controls the production of testosterone by the testes. The pineal gland produces a hormone called melatonin. Melatonin is produced in greater quantities during hours of darkness. As nights get shorter (i.e. day length increases) melatonin decreases, LH increases, and antler growth begins.



## The Antler Cycle

Members of the family Cervidae are the only animals that develop antlers. In North America this includes white-tailed deer, mule deer, elk, moose, and caribou. We will discuss the antler cycle of whitetails, but the basics are similar for each species. Caribou females are the only members of the deer family that commonly develop a set of antlers each year. Antlers are a fascinating & unique type of animal tissue that are grown & shed annually. Antlers are true bone composed of calcium and phosphorous, and many other trace minerals. But, unlike most mammal bones they are without marrow. Often one hears deer antlers referred to as "deer horns", but horns are composed of non-living tissue called keratin which makes the horn sheath that covers the horn core. Horns are not shed annually, with the exception of pronghorn antelope, and continue to grow from the base throughout the animals' life.

When a buck is born, he has two swirls of hair on his forehead, showing where the antlers will develop from as he gets older. At about 4 months of age, bony knobs called pedicels appear on the forehead or frontal bone of the skull. The pedicel is where all the antler growth originates from each year.

The antler cycle is regulated by the level of the male hormone testosterone. This cycle involves an interaction between the testosterone level and the antler-growth stimulus of the pituitary gland, and the photoperiod. Photoperiod is the relationship of daylight & darkness.

Antler growth normally begins in late-April when new antler material starts to swell at the pedicels. This beginning antler growth is known as the base or burr. Antler growth occurs at the tip of the beam and tines and not from these bases. As the antlers grow, blood is circulated up through the pedicel to the inside of the new antlers. While the antler is growing it is a soft cartilage. The outer skin of the antler is called "velvet". This skin or velvet also has many blood vessels that supply nutrients and deposit materials that build the antlers. The skin is composed primarily of protein and is covered with thousands of tiny hairs less than  $\frac{1}{4}$ " in length. The velvet covering contains many nerves and is very sensitive to touch. Injuries occur easily to this soft sensitive growing bone; however, bucks take deliberate pre-cautions not to injure new antler growth. When the velvet or new antler growth is cut or broken, profuse bleeding can occur for several seconds. Blood clotting is rapid.

Antler growth begins slowly for the first 30-45 days. By June, most of the bucks that are growing antlers with 8-10 or more points will have 6 points showing (brow-tine and the first fork of the main beam or G2 point). From mid-June to mid-July, antler growth is incredibly rapid in most bucks two years & older, with points growing up to  $\frac{1}{2}$ " per day. Most bucks have all their points showing by mid-July, but each point can grow in length until the first of August.

The entire antler growth process normally takes about 100 days and antler formation is said to be the most rapid tissue growth known in the animal kingdom. Elk and moose can grow up to 30-45 pounds of antlers each year during this short period.

By mid August when antlers are fully developed, hormone levels result in diminished blood supply to the velvet, the soft cartilage is replaced by calcium, phosphorous, and other minerals. These new antlers begin to harden and become bone. At this time, normally during the first-three weeks of September, the bucks strip drying velvet from their antlers. Some velvet actually falls off antlers but most velvet is removed by rubbing the antlers on trees and branches. This process normally takes less than 24 hours. Often the velvet still contains blood and bleeding occurs at the time of velvet removal that stains the hardened antlers. At this time, the level of testosterone begins to increase, stimulating the buck into the breeding cycle.

From September through January, bucks use their antlers in sparring and fighting matches or simply as "display organs" in order to establish their place in the hierarchy of bucks in a given area or population. As the daylight hours begin to increase in January through March, the level of testosterone decreases as a result of the pineal gland producing a hormone called melatonin. This process causes the antlers to separate from the pedicel. Antlers normally fall off on their own and this casting or shedding of antlers occurs every year. It is thought that each buck is genetically programmed to respond to a specific point in time (photoperiod) and cast antlers on nearly the same day each year. I have been observing a group of ten bucks for the past six years and this statement is true for these bucks if each buck is in good physical condition. If a buck is injured or becomes ill, it will cast antlers earlier than its normal casting period. The loss of antlers causes the buck no pain. Both antlers may drop off simultaneously or one antler may shed one day and the other a week later. It is rare to find a matching set of cast antlers. As antlers near casting time, they can be knocked off when a buck crosses under or over a fence, or knocks an antler on an object such as a tree limb. . Sometimes a portion of the pedicel remains attached to the burr when an antler is knocked off. After the antlers are cast the process of growing a new set of antlers begins again.

No two antlers are alike. Each set of antlers has a unique and fascinating shape. The design of all antler sets is genetically based & environmentally (nutrition & age) influenced assuming no injuries to body or antler occurs. Since antler size & shape is genetically based it can be said that no amount of feed can produce large antlers on a buck that is genetically programmed to grow small antlers, regardless of age. And likewise, a buck with the genetics for large antlers will reach his antler growth potential only if adequate nutrition is available and he reaches the age of 4-6 years old.

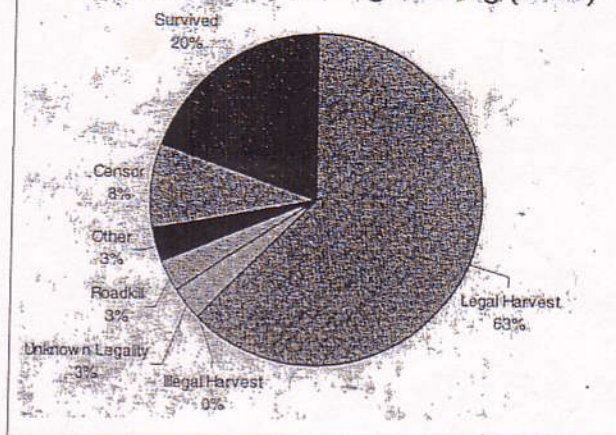
Of adult bucks, those 2½ or older, 20 percent survived the hunting season, as what would be expected under the new antler restrictions.

as fall mast production and winter severity. These conditions can modify winter survival by increasing or decreasing fat reserves and allowing or hampering movement in the winter months. These conditions also affect the following year's antler development.

Based on the first two years of this study, antler restrictions are allowing about 50 percent of yearling bucks to survive their first year as antlered deer. Just as important, Pennsylvania hunters are adjusting well to the new regulations.

Based on our research, antler point restrictions are doing what they were designed to do, that being to protect at least some of the yearling bucks from harvest to allow them to enter their second year of life, and grow their second set of antlers. However, we will be collecting additional harvest data, which will give a substantial boost to the sample sizes of yearling and adult age classes. About one-third of all bucks caught this past winter were already yearlings or older, so the adult age class will be well represented in this, our third year. After the 2004-05 hunting season, we will be analyz-

Figure 2  
Adult Mortality During Hunting (N=35)



ing all three years of data to look at the overall effect of antler restrictions on our buck population. Final data collection will occur during the 2005-06 hunting season, when the surviving yearlings from the 2004-05 hunting season become available for harvest as 2 year olds.

Critics of antler restriction regulations often tell us they do not work. They even tell us why they don't work, even though they have little if any data to support their claims. Results of this research will allow us to address these issues, and provide a comprehensive evaluation of antler restriction regulations on deer management. □

#### COVER PAINTING BY BOB SOPCHICK

You're posted at the edge of a forest when you catch movement out of the corner of your eye. You slowly turn your head and can't believe your eyes. He's a big one; no question about meeting antler restrictions on this one, and he's likely to bolt off after those does at any moment. Don't rush the shot, however, and risk a miss. Take your time to make sure your sights are on and steady before squeezing the trigger. With this as the third year since the new antler restrictions were put in place, big bucks like the one featured on this month's cover are more likely to be found than at any other time in our history. Just be patient and keep your eye peeled — and most importantly, have a safe and enjoyable season.



\*\*Adapted from: *White-Tailed Deer: Ecology and Management*  
Stackpole Books, 1984

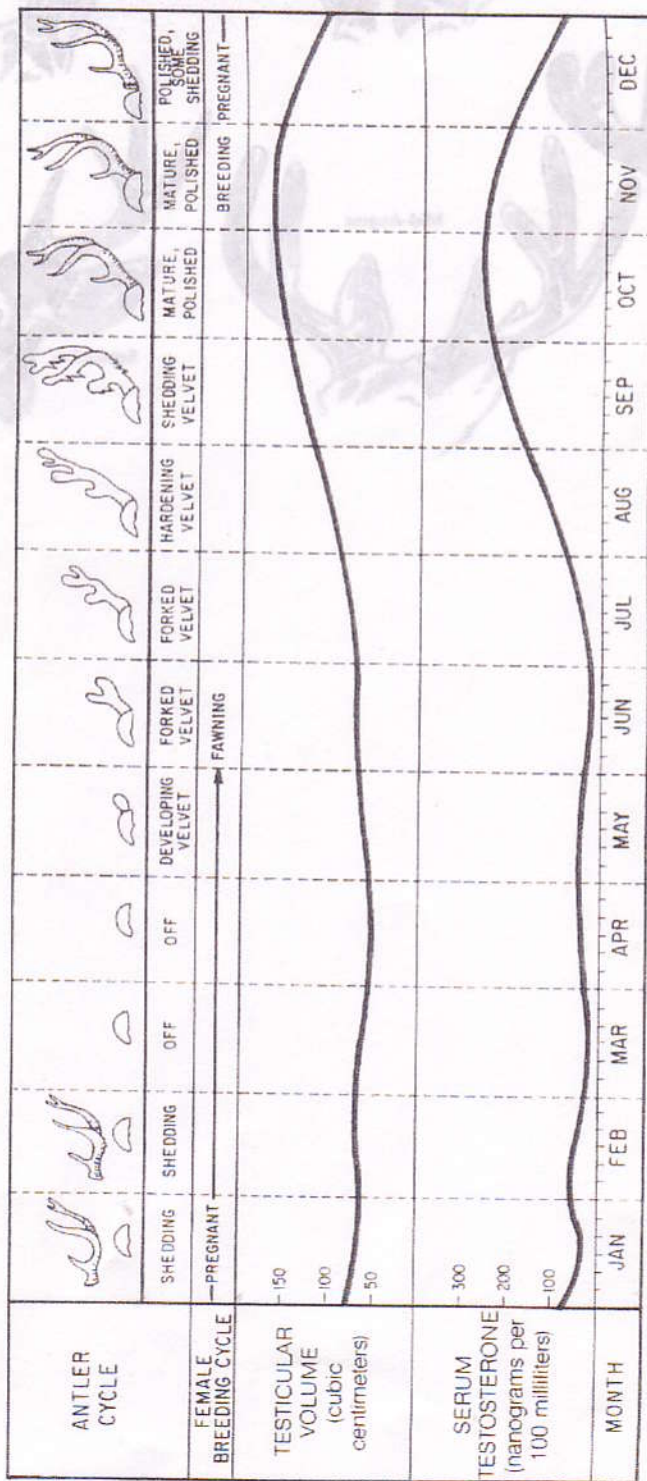
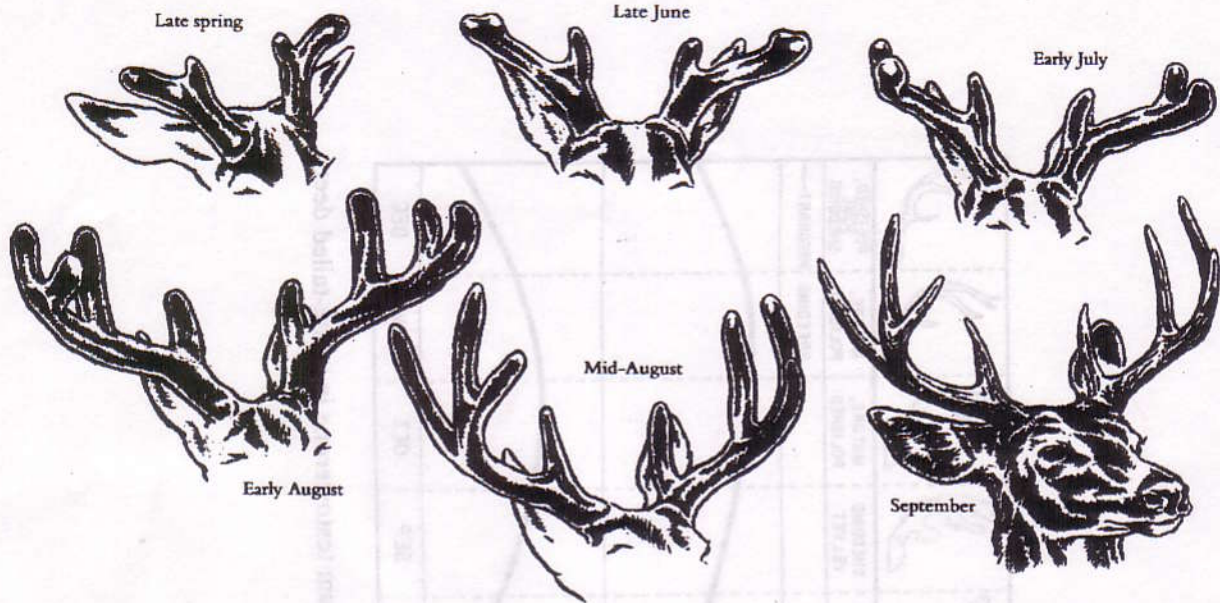


Figure 35. Relationship of antler growth and breeding cycle to testicular size and serum testosterone in white-tailed deer (McMillin et al. 1974).

# Deer Antler Cycle



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