

BY DR. JAMES C. KROLL

The World Of Whitetail Antlers
Part II: What Happens Along The Way

In Part 1 of our antler growth discussion (see the August issue of ***North American Whitetail***), I discussed how we believe antlers came to be the unique appendages in the deer family, first possibly as scent dispersal or display organs, then later evolving into their primary role as defensive and male combat organs. Whereas antler-like appendages were permanent protuberances from the frontal bones of the skull, modern antlers grow during a certain time of the year (depending on the hemisphere), die and remain attached to the skull for a period of time, then are cast to start the process anew. In this installment, I will discuss how antlers grow, the genetics of antler growth and what can happen during their growth.

Even as very young fawns, bucks begin growing the all-important pedicel from their frontal bones. Development of the pedicel is controlled by testosterone, the primary male sex hormone. Most buck fawns have a well-developed pedicel by 5-7 months. Whitetails are short-day breeders. The amount of hormone produced is determined by length of day. Oddly enough, the buck measures length of day inversely — by measuring the serum concentration of melatonin produced by the pineal gland in the brain. Since more melatonin is produced at night, the buck's brain can measure the concentration in the blood to obtain day length. Melatonin also affects another gland (hypothalamus), which consequently influences testosterone production. Another hormone, IGF (insulin-like growth factor), is produced by the liver under the direction of the pituitary gland. Yes, I know this is complicated, but stick with me!

So, two primary hormones regulate antler growth: testosterone and IGF. The latter promotes antler growth, while the former affects antler hardening and velvet stripping. IGF tends to peak in late September to early October, while testosterone peaks just about the time scrapes begin to appear in large numbers. The proper timing and dosing of these and other hormones will determine a great deal about the antlers produced by a buck.

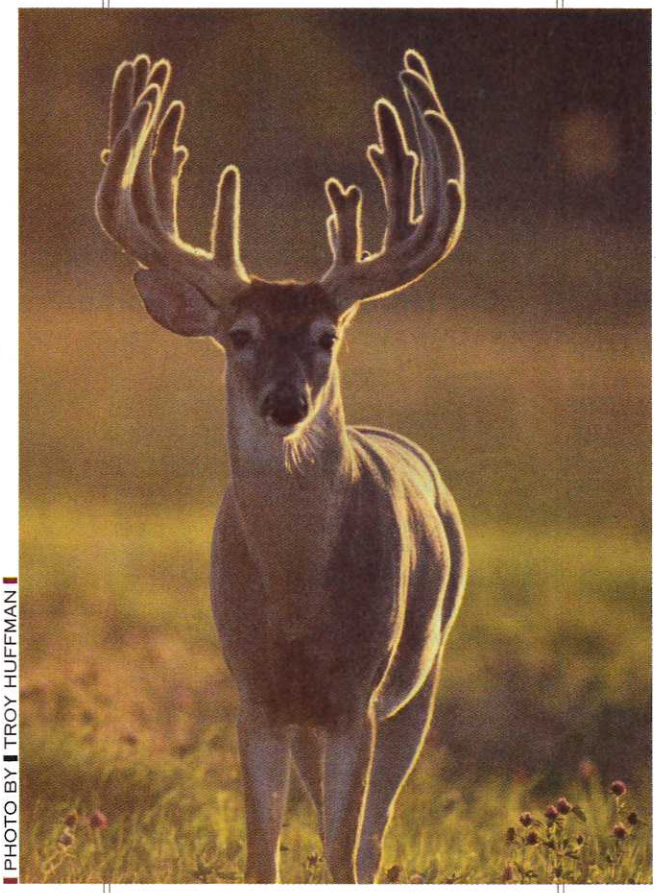


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Selenium is a critical mineral component to antler growth. Selenium concentrations are usually at their highest in the tips of tines and beams in developing antlers.

New antler bud tissues are not unlike stem cells. Within them is the genetic coding needed to produce antlers. I often am asked about bucks that lose a considerable piece of bone from the pedicel during casting. Oddly enough, damage to the pedicel bone usually does not produce subsequent antler deformity. Yet, let that small patch of new antler bud tissue get damaged, and the result can be devastating! In addition, small patches of cells can become dislodged from the antler bud, migrate to another location on the head, and grow into additional antlers!

Antlers are similar to bone, and as such, they have what amounts to "bone marrow" in their core, around which is a hardened case of denser, bone-like material. One of the misconceptions about antler growth is the buck grows the antler first as cartilage, which later turns to bone as the antler matures. In reality, there is a growing tip of cartilage material, but it is being replaced from beneath by boney material as it grows.

If an antler tine or beam is broken during growth, and it is not too far into the growth cycle, it can repair or at least partially mend itself. Sometimes damage will create unique "non-typical" tines, which probably will not be reproduced next year. One of the most commonly reported aberrations are "acorn" points. I have heard all sorts of explanations for these, but my observations indicate they occur when a buck jams his antler tips on some object such as a tree limb. The soft tips are broken or shocked; then the damage tissue heals, producing the characteristic acorn-like tip. Other misconceptions include places along the beam and tines where there are holes. These are not where a tick or insect resided; rather, they represent tears in the velvet due to accidents.

The antler grows around the damage and continues on, leaving the hole.

Mineralization goes on throughout antler growth. The soft antler is about 80 percent protein and 20 percent minerals. Once mature and hardened, the amount of protein drops to about 50 percent and the remainder is made up of minerals. Calcium and phosphorus are the most common minerals, present in a ratio of about 2:1. Other minerals include magnesium, sodium, potassium, barium, iron, aluminum, zinc, manganese and selenium. Selenium is the most interesting to me. My measurements over the development of velvet antlers are similar to published reports. Selenium tends to be at its highest concentration in the tips of developing tines and beams. Selenium is important to cell division. It is a heavy metal and is only used in very minute quantities. I have seen landowners give their bucks heavy metal poisoning by over-supplying this critical micro-nutrient.

The blood supply to the growing antler is anatomically interesting. Blood moves up the outside of the antler through arteries and back to veins around the antler base via the internal marrow-like cavity. A break in the antler can produce large amounts of blood, but the buck manages to shut off the flow within an hour or less. The blood flow is so intense, and there is so much growth activity, the antler actually feels rather warm to the touch.

Antler growth comes to an end when serum testosterone levels rise with shortening days. By this time, the antler is fully mineralized and blood flow is greatly reduced. Two interesting things happen at this time. First, the velvet begins to dry, shutting off blood flow. This is caused by formation of the "burr" as a ring of dense bone around the base just above the pedicel. The pressure of the burr against the thin velvet pinches off blood flow. Note also the interior base of the antler is fully mineralized, cutting off return flow from the spongy core.



PHOTO BY RON SINFELT

Controlled breeding of whitetail deer — which has resulted in some cases in magnificent racks like that of Pennsylvania's legendary Goliath — has taught biologists a great deal about the role genetics can play in antler development.

Within a few hours, the velvet dies and falls away, leaving blood over the surface of the antler. This is the first stain applied to the antler. Later, the buck will supplement the coloration by rubbing trees. Antler development is complete, less than 200 days after casting.

What Makes "Big" Antlers?

There are a lot of misconceptions about antler growth and what makes "big" antlers. So it would be appropriate to begin with a short discussion about the following issues:

- Genetics
- Age
- Nutrition
- Physiological stress
- Physical damage history

I placed genetics first on the list, although genetics seldom is an issue in most deer management scenarios. There is a great deal of fanciful thought about genetics — and it's too often over-simplified in my opinion. Genetics discussions distill down to topics such as whether or not spike-antler yearlings are genetically inferior, the role of the bucks and does in the genetic equation and the number of genes at play in antler size and appearance. All this leads to a general perception, even among some biologists, that manipulation of genetics is a "quick fix" to growing large-antlered bucks. Yet, here are the facts as we currently know them.

There is not a single published study (scientific or popular) that documents the presence of an "antler gene!" Much of the heated discussion you may have heard or read is predicated on the idea that deer are no different from Gregor Mendel's green peas. Mendel was a monk who is credited as being the father of modern genetics. He worked with garden peas and came up with the hypothesis that dominant and recessive genes, when combined by mating, influenced color, texture and size of fruit and plants. It is an erroneous extension of Mendel's genetics to think a buck carries the antler gene and has the primary influence on his sons' antlers. Presumably, under this model, the doe is just an incubator for growing fawns! The truth as I see it, is that there are multiple genes affecting antlers, and the doe probably carries the lion's share of the important ones. Factors such as the amount of milk produced, the efficiency of food conversion, temperament and other behavioral factors all have impacts on antler growth. Although we have no idea where any of these genes reside, it is important to note 90 percent of the Y-chromosome from the male is inactive, leaving a lot of potentially female sex-linked genes to play in the game.

Controlled breeding of whitetails by deer farmers, whether you support the practice or not, taught us a great deal about how the mega-bucks taken in the wild end up decorating the cover of ***North American Whitetail*** magazine. In most cases, to produce bucks like Goliath, deer farmers back-bred bucks to related does (mothers, sisters, aunts) to concentrate physical traits. This takes several generations of controlled crosses to accomplish.

Knowing this, let's examine how a buck like Milo Hansen's world-record typical (213 5/8) is truly special.

First of all, Ben Koerth and I conducted a study on free-range antler development in south Texas, discovering less than 15 percent of buck fawns, even on well-managed ranches, ever broke 150 Boone & Crockett inches in their life! When you raise the bar to 160, 170 or even the 200s needed for a new world-record typical, probabilities drop to several places right of the decimal point! Next, in order for a young buck to be the offspring of the right doe and buck, a lot of serendipity has to occur and probably involves two highly related partners getting together to form a "natural" backcross. When you add age to the mix, it is a true wonder any buck ever grows world-class antlers in the wild.

Antlers grow from the frontal bones of the skull. Even as very young fawns, bucks begin growing the all-important pedicel from these bones.

Age always is a factor in antler size. The study Koerth and I conducted clearly showed at least 95 percent of antler size is attained by 4 1/2 years. In most areas where monster bucks have been taken, there are additional factors (season timing and length, hunting weapons, etc.) operating that favor production of reasonable numbers of older bucks. And the age factor creates an additional issue. DNA ages and things can change as a buck ages. Further, there is evidence that damage during antler growth over several years can significantly adjust the genetic blueprint. Thankfully, that is why attempts to clone whitetails have not met with the anticipated success.

Nutrition probably plays as great a role in the size of a buck's antlers as any one factor. The most critical time for a buck occurs between antler casting and the first growth of the antler bud. A great deal is going on inside the buck at this time, but you really can't see much happening. The buck must replenish reserves lost during the last antler cycle, as well as those used up in combat and breeding. Hence, the higher the quality of diet during this time, the greater the chances the buck will realize his true genetic potential. That is where food plots and supplemental feeding (where legal) become important to any management program. However, in northern climates there often is little to eat during this time. The only thing you can do is make sure the buck comes into the breeding season in as good a condition as possible. Again, that is where the added nutrition of native and cultivated forages becomes critical. Deer density and sex ratios also affect nutrition. The more bucks on your property, the less stress on each individual. Further, the fewer mouths present, the better the condition of your bucks. That makes proper harvest very important to quality buck management.

There have been many studies supporting the role stress plays in antler size. Social position can affect antler size, primarily by increasing the amount of stress on the buck. Deer may appear to be docile animals, but if you watch them carefully, they employ little "nudges" to intimate others in the group. Sometimes it turns into more violent affairs, such as "kick boxing" matches between bucks. Other sources of stress include weather conditions (heat, lack of rainfall, winter temperatures, etc.), disease and predator and human disturbance. Deer exposed to prolonged chasing in winter can react with lower antler growth the following spring. Finally, nutritional stress (as discussed above) is one of the most important considerations in antler growth.

When you consider all of the aspects of antler growth discussed in this article, it is a wonder indeed any buck ever grows into the trophy we feature each month. Each year is a different challenge for a buck. The monster you saw last season may be unrecognizable next season! I have many records of high-scoring bucks that turning into mediocre bucks after a harsh year or heavy breeding and, for that matter, vice versa. If you are managing your deer, you can see why it is important to consider nutrition first in your management program. If you do, genetics will take care of itself!

***(ON TARGET** Cont. from page 10)*
before attempting a hunt. The perfect kill zone on a deer is larger than a dinner place.

Then why do so many hunters miss the mark? The thought process they applied when shooting at a deer was quite different from the one used to practice and sight in the bow. To be successful, pick the spot you want to hit and concentrate on it. Let the sight pin float (or jiggle) on or around the desired impact point and shoot the same shot you have perfected during practice.

Whether taking a shot on the practice range or at a prize buck, trust your form and ignore the movement of the sight pin. Naturally, there could be considerable repositioning of the pin when attempting a hit a trophy whitetail. However, trying to guide or hold the pin in one spot will redirect the pressure on the bow. The resulting tension will alter the flight path and make the sights ineffective. In addition, once you begin executing the shot, do not try to fine-tune the sight pin. This will start and stop the shot process, causing the forward pressure on the bow to be lost. With compound bows, more than 90 percent of the misses stem from the bow arm. As long as the bow arm has steady pressure straight at the target, the result will be the best shot you are capable of performing at the moment. Prove this to yourself. Go to the practice range and make 20 shots, letting the sight pin float and maintaining steady pressure on the bow as it presses toward the target. Then shoot 20 shots while attempting to hold the sight pin on the bulls-eye. The results should convince you to trust your form and shoot. The forward pressure of the bow arm is a correcting measure for the extra sight movement. When a hunter starts and stops the shot process, "buck fever" will intervene and disaster will follow.

Accomplished archers spend considerable time practicing and honing their skills. Make it your goal to practice, so it will enhance your power of focus and develop muscle memory. Then, when it's time to ascend your tree stand, you will be mentally and physically prepared for that shot opportunity. Capturing a whitetail can be just as easy as shooting on the practice range. Remain calm, focus on shot execution, and trust your form.