



March 2014

Selective Buck Harvest to Increase Antler Size: Is Genetic Change Realistic?

By:

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Selectively harvesting bucks in wild deer populations can positively influence antler size in the standing crop (the deer age classes or cohorts alive on your property). If you have improved survival of larger-antlered bucks, and a live buck will certainly sire more offspring than a dead buck, then it seems reasonable that shooting the smallest bucks in an age class should change the genetic composition of the population, resulting in larger antler size. Let's take a close look at some recent research to see if this expectation makes sense.

Researchers at the Kerr Wildlife Management Area (Texas Parks & Wildlife Department) conducted eight years of intense selection on antler size to determine if they could change the antler quality of deer in a controlled (non-wild) breeding environment. Young bucks from 6 to 18 months of age received a sub-optimal diet consisting of one-half of the normal quantity of protein pellets, and about 6 percent crude protein. This level of crude protein content allows deer to survive and maintain themselves, but does not provide enough nutrition to express their full potential for antler growth; allowing them only one-half of their normal intake rate insured they were nutritionally stressed. Researchers hypothesized that the bucks that grew the biggest antlers in a nutritionally-stressed environment must have the best possible genetics for antler growth. Each year, the researchers selected the yearlings that grew the largest antlers and used them to sire the next generation. They also removed some mothers that produced sons that grew small antlers and replaced the original does with doe offspring of the larger-antlered sires as they became available. In other words, they intensively selected both bucks and does that did the best job of expressing genetic potential for large antlers. After eight years of intensive selection, the researchers recorded an increase of 3.2 total antler points and a 36-inch increase in gross Boone & Crockett score of yearling bucks. The study provided strong evidence that intensive selection of bucks and does in a controlled environment could change the genetic potential for antler development, resulting in larger antler size.

Selection clearly works in captive deer, but what about in wild deer? The main questions are:

- 1) How much gain can be expected in a wild population?
- 2) How intense does selection have to be to increase antler size?
- 3) How long will it take to increase antler size?
- 4) What is the cost?

These questions are hard to answer in the wild because of the time and effort involved in ranch-level intensive research. However, we can use the science of quantitative genetics – the basis for animal breeding and production traits – to model the efficacy of selection on antler traits in wild deer. Using quantitative genetic models, we simulated an intensive harvest program to determine how efficient selective harvest would be at altering genetic composition to increase antler size in wild populations. We made sure our model simulations were accurate by also simulating the controlled breeding done in the Texas population of captive deer.

Making the Models

First, we needed to overcome the limitations of previous models and better represent conditions encountered in the wild. So, we used a modeling approach that simulated real-world transmission of genes between generations. Also, the computer models allowed us to adjust parameters to simulate different scenarios, such as age structure, population size, and sex ratio.

We set up our first simulation to be comparable to conditions in the intensive selection study conducted by Texas Parks and Wildlife Department. Simulating an actual research population gave us a way to validate our computer models by comparing our simulation results to actual results. In this simulation, we were able to apply selection to both bucks and does because breeding can be controlled in captive populations and pedigrees were available to assess female genetic potential on male offspring antler size.

For our second simulation, we modeled response to selection under conditions that simulated free-ranging populations.

Model parameters included:

- 1) Deer population size
- 2) Age structure
- 3) Mating success (similar to sex ratios observed in the wild)
- 4) Heritability of antler characteristics

Other variables included:

- 1) Selection was applied only to bucks (since breeding is not controlled in the wild – a major difference between wild and captive populations)
- 2) Models removed the number of antlered bucks equivalent to the number of buck fawns produced to replace them (to maintain population size)
- 3) Annual natural mortality of bucks was 18% and 11% for does
- 4) Fawn survival was based on estimates across the southern United States, and were relatively high, which allowed us to apply heavy selection to our buck population (to get the greatest response possible)

The model removed an average of 42 percent of the entire breeding buck population every year based on antler size. In other words, if there were 100 bucks in the population, it removed 42 bucks with the smallest antlers across all age classes. And our computer model was much more effective than the typical group of hunters in removing the smallest bucks; the model evaluated antler size of every buck and selectively removed only the smallest antlered bucks. In most wild populations, large antlered bucks also are harvested as trophies, which would reduce the response to selection. Because our simulations offer a best-case scenario of selective harvesting of deer with the smallest antlers, obtaining changes in antler size in the real world comparable to, or greater than, our results will be highly unlikely.

Our Results

Our first round of simulations, mimicking the captive population, showed improvements in antler points and antler score that were very similar to the observed values of the actual captive population studied in Texas. This provided us with confidence that our model accurately represents selection for genetic effects in white-tailed deer. Therefore, our free-ranging simulation results should accurately model the process of selection under wild conditions.

Contrary to findings from our captive simulations, selection for increased antler points in free-ranging populations did not result in significant improvements, even after 20 years of selection. This long effort amounted to selective removal of almost one-half of all bucks every year for seven generations of deer. For all of the effort, the number of antler points increased by less than 1 point for 3-year-old and 7-year-old bucks! We didn't model improvement rate for total antler score in the free-ranging simulations (for technical reasons) but it would likely improve at an equivalent rate as antler points. We conclude that selective harvest for genetic management is very difficult, if not impossible, to achieve in the wild.

Let's translate this rate of improvement to your property. What's the best case scenario you could expect after 20 years of removing about half of your buck population every year? If your average 4-year-old buck has 9 points and a gross Boone & Crockett score of 119, then after 20 years you could expect to have 4-year-old bucks averaging 9.6 points and 127 B&C. As a manager and hunter, you will have to decide if that level of improvement is worth the effort. However, if the level of selection falls below our modeled levels, and if harvest of large antlered bucks is practiced, then don't expect to even get that level of improvement. By harvesting both small and large antlered bucks, the remaining population of deer has average antlers, and presumably the genetics that code for that antler size.

Why Didn't Selection Work in the Wild?

The lack of observed response in free-ranging deer populations is complicated by a number of factors. Some of these factors we can control and others we have no ability to influence.

Intensity of Selection: Maybe the most important complicating factor is intensity of selection of deer in wild populations. Our models removed about half of all bucks every year and made no harvest mistakes. The penned study removed an amazing 85 percent of their bucks from the population every year! There is no way that a wild population of deer could ever be harvested at this intensity and be sustainable, nor would you want to because the number of older bucks in the population would be very small. A large percentage of younger bucks must survive to have a reasonable number of older bucks available for appreciation and ultimately for harvest.

Selection of Does: Another complicating factor is the inability to apply selection to the doe segment of a wild population. Obviously, females cannot be selected based on their expression of antler size.

Movement: Another major problem when it comes to changing the genetic composition of wild populations is the constant movement of deer among populations, or dispersal. The immigration of yearling bucks constantly introduces genetic diversity back into the managed population. This genetic diversity dilutes the targeted gene pool, potentially negating any change you're trying to produce through careful selection. And, not only will new bucks immigrate into your population, the bucks you're trying to select for will also emigrate out of it. As you can imagine, all of this

coming and going makes it very hard to have much control over the genetic makeup of a wild deer population.

Environmental Variation: Finally, antler characteristics in free-ranging populations are affected by environmental variation. For example, year-to-year variation in rainfall changes the expression of genetic potential for antler size, affecting your ability to decide which animals should be removed from the population. In other words, the changing environmental conditions that deer experience weaken our ability to effectively select for genetic potential in antler development. With captive populations, environmental factors are much less variable, allowing the actual genes for antler size to be more accurately targeted for selection. But again, this likely is not possible in free-ranging populations of deer because the management practices of penned deer are not directly transferrable to wild populations.

Conclusions

So then, is genetic change for increased antler size realistic through selection in the wild? Likely not. However, selective harvesting can have a place in most management programs, but for reasons other than genetic change. Selective harvest can still be applied to the standing crop of bucks, which would remove the bucks with the smallest antlers in each age class, thereby allowing a greater proportion of the larger antlered bucks in each age class to move on to the next age class. However, this practice assumes that bucks can be aged accurately on-the-hoof. This philosophy incorporates two of the most widely used and successful management techniques for increasing antler size. First, allow bucks to reach older ages because antler size increases with age. And second, by removing smaller bucks in each cohort, along with an appropriate doe harvest, will afford the remaining deer in the population access to greater nutrition either in terms of quality and/or quantity. The premise of removing the smallest bucks from the standing crop does not imply a genetic change, but rather will allow larger-antlered bucks to grow older and take advantage of greater nutritional resources.

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Further reading:

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