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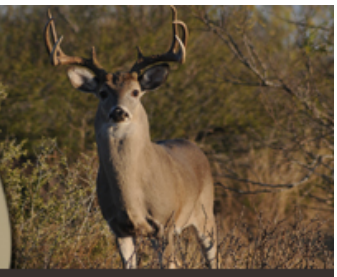


The Bell Curve of Mature Buck Antler Scores:
When You Manage a Buck Herd, You Manage a Bell Curve of Antler Scores

By Stuart W. Stedman

Summary of Part I: Bell Curve Basics

Mature buck antlers are distributed in a bell curve. The *average* locates the bell curve along the horizontal axis; the *standard deviation* (a measure of variation) defines its shape. A solid understanding of the bell curve is important because a deer manager essentially manages a bell curve of antler scores when he manages bucks. That antlers are distributed in a bell curve makes sense because its Nature's way of rewarding the most successful individuals in a population—the averages—while maintaining a few non-average individuals that can thrive if the environment changes. Finally, even though the goal of most deer managers is to produce large-antlered outliers, outliers are statistically rare and extreme outliers risk lack of *fitness* in an environment.

Summary of Part II (Chapters A and B): The Bell Curve as a Management Tool

The two most powerful uses of bell curve analysis are 1) **Bell Curve Shifts (Right and Left) As a Result of Nutritional Changes** and 2) **Changes in the Size of the Bell Curve (as a result of more *buck fawns on the ground*).** Combined, the effects of a rightward shift and increase in the size of the bell curve—both the result of diligent supplemental feeding over time—are powerful and dramatic. Part II also presents probability tables that a manager can to estimate the number of bucks in each antler class he will have in a particular year and to construct his own bell curve for his ranch

Part III
A Deeper Dive Into Bell Curve Thinking and Analysis

This Part III dives deeper into bell curve analysis and explores the impact of two management practices on the bell curve: 1) the impact of culling; and 2) the impact of shooting spikes.

Culling and the Bell Curve

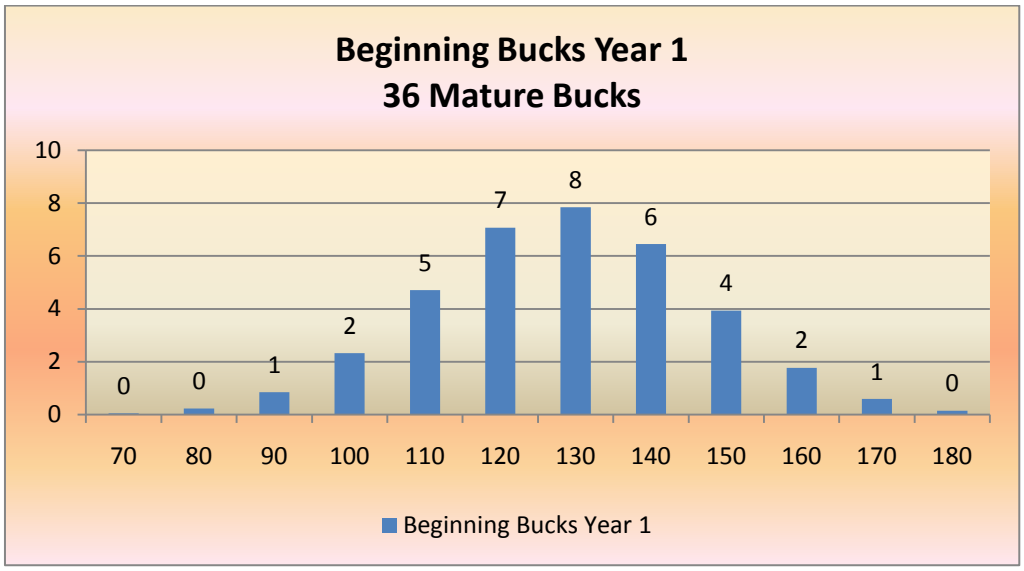
Deer managers love to cull. Culling gives them (and their hunters) something to do. The problem is that the positive effect of culling is most often overstated. I firmly believe that it is impossible to effect genetic change by culling bucks, but that is a topic that is beyond the scope of this bell curve series. Bell curve analysis can help a manager visualize the actual impact of culling on his deer herd.

In this culling-bell curve exercise, I make the following assumptions about a culling program:

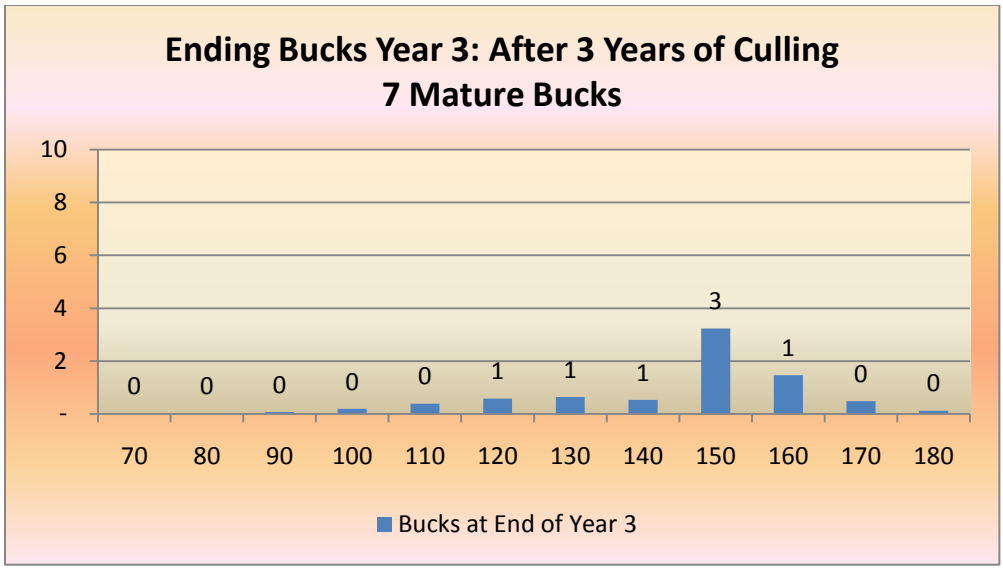
- This culling exercise lasts 6 years: 3 years of intensive culling and then no culling for years 4 through 6.
- The beginning number of mature bucks is 36, the number of mature bucks at the 5,000 Illustrative Ranch (at a density of 25 acres/ adult deer) described in Parts I and II.
- I assume average nutritional conditions throughout the 6 years of this exercise.
- 11 bucks become 5 ½ years old (i.e. mature) each year.
- Hunters cull 80% of the mature 140 B&C and smaller bucks.
- Hunters and natural mortality take 25% of the 150+ B&C bucks each year.

I believe these intensive culling program assumptions represent a reasonable program that a manager might implement. So what does the mature buck herd look like in year 6 after 3 years of intensive culling? (Note that this is NOT a genetic exercise since any buck fawn born in year 2 would be 4 ½ years old and not yet be mature in year 6.)

Before the culling program begins, the mature buck antlers are distributed as follows :

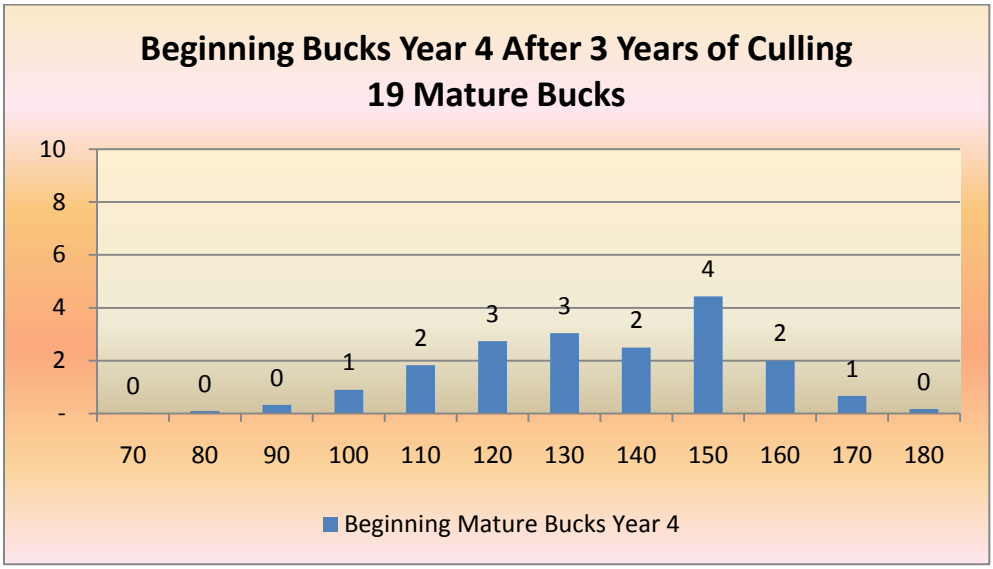


At the end of 3 years of intensive culling, number of mature bucks is down to 7 from 36 but there is a higher percentage (not numbers) of 150+ bucks as the following graph shows:



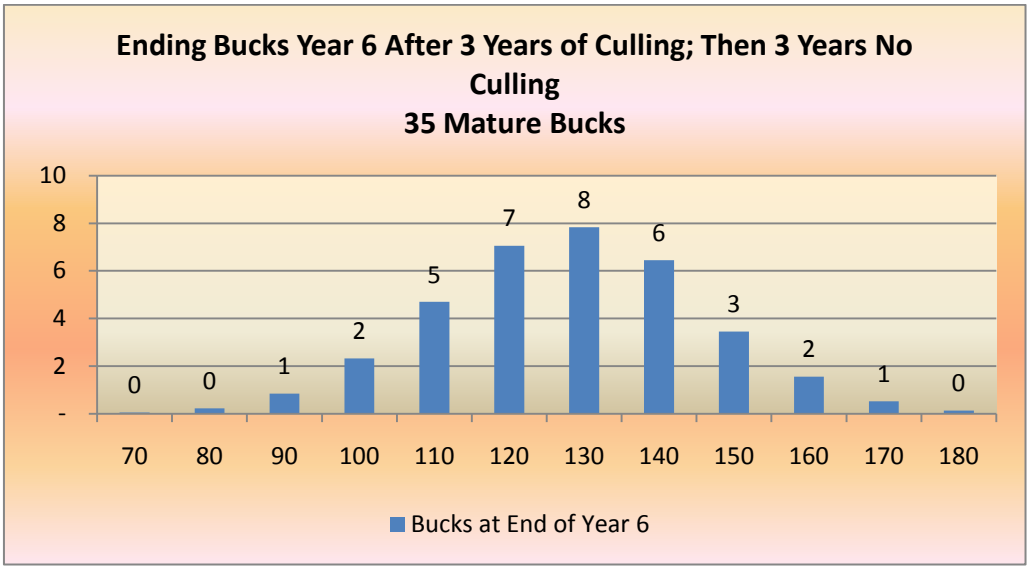
By the end of the third year, the manager has in effect lopped off the left portion of the bell curve with 3 years of intensive culling.

At the beginning of year 4, another class of 11 bucks reaches maturity so year 4 begins with 19 mature bucks and a high percentage of bucks score 150+. The bell curve shows the bulge of the 11 new bucks—the antlers of which are all distributed in a bell-shaped curve:

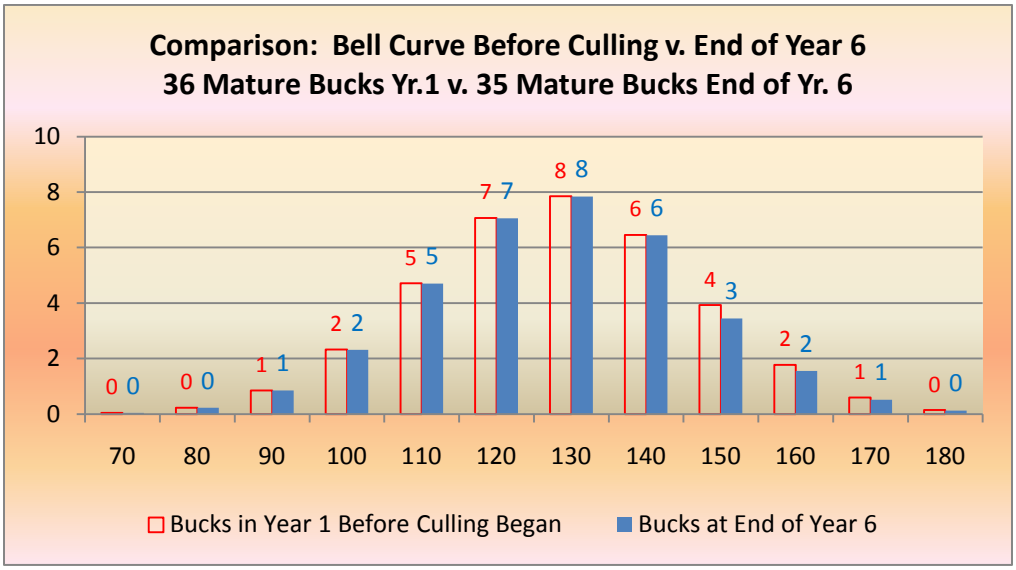


The above graph shows clearly the new crop of bucks entering the mature age class, the antler sizes of which are distributed in a bell shaped curve. But the graph also shows the disproportionate number of 150+ bucks, the bucks the manager harvested less intensely in the first 3 years of intensive culling.

After year 3—i.e. starting in the 4th year of this exercise—the manager stops culling. Three new classes of bucks—one in each of the 4th, 5th, and 6th years—enter the mature buck age classes. The following graph shows the bell curve in year 6, three years after the manager stopped culling:



Three years after a manager stops culling, the bell curve of mature buck antler scores is virtually identical to the bell curve in year 1 before culling began. For comparison, the following graph shows the bell curve at the beginning of year 1 (red bars) and the bell curve at the end of year 6 (blue bars):



This culling exercise demonstrates two important deer management points:

1. Culling simply lops off bucks on the left side of the bell curve. Although culling reduces the one's supplemental feed bill (and that's a good thing), culling does not improve antler quality.
2. The impact of culling is temporary. Once culling stops, new crops of bucks—distributed according to the bell curve—become mature each year and the bell curve eventually reverts to its original shape. Bell curve analysis allows one to visualize that process.

Culling is an emotional topic. Although the above culling exercise stopped short of any arguable genetic change (remember the fawns born in year 2 would have only been 4 ½ years old in year 6), many managers believe that culling effects genetic change. Not true. Culling efficacy is beyond the scope of this bell curve series, but the basic reasons culling doesn't change genetics are several: 1) 50% of the herd—does—do not have antlers and cannot be culled; 2) one, two, and three year old bucks breed—a lot; 3) culling intensity is difficult to achieve beyond just a couple of hundred high-fenced acres; and 4) phenotype does not equal genotype (i.e. environmental factors often mask underlying antler genetics).

Is culling pointless? No. At Faith Ranch we cull mature bucks intensely for 2 reasons: 1) guests think culling is fun and 2) culling reduces our feed bill. But we do not harbor any illusion that our culling efforts will result in any improvement in long term antler quality through genetic change.

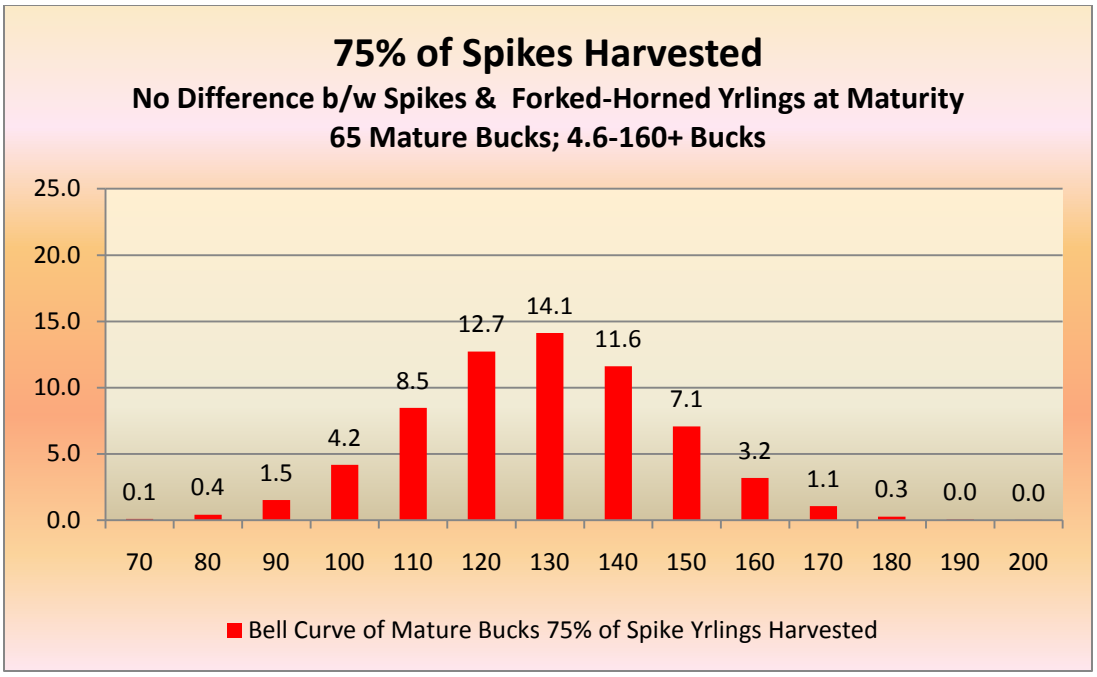
So how do you increase the number of 160+ bucks? Part II of this bell curve series contains the simple answer: 1) you increase nutrition to shift the bell curve to the right and 2) you increase buck fawns on the ground to make the entire bell curve (and therefore the number of 160+ bucks) bigger.

Spikes and the Bell Curve

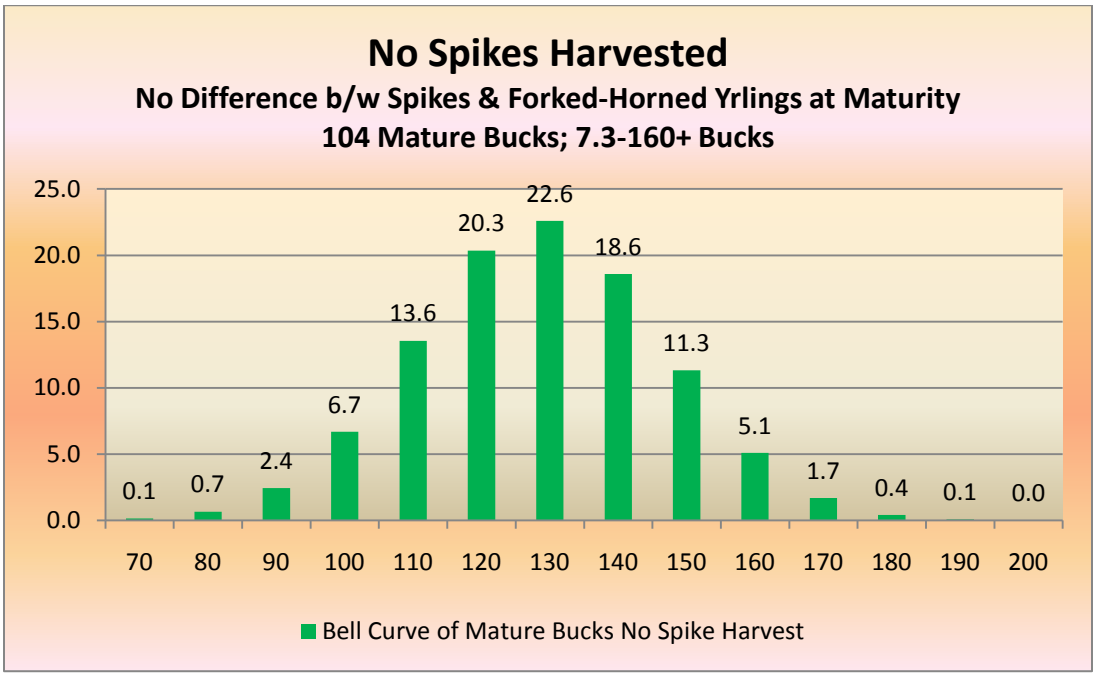
As part of my deeper dive into bell curve analysis, I decided to use the bell curve to analyze the effect of killing spikes on the number of 160+ bucks. When I first looked at this question, I applied basic bigger-bell-curves-are-better-logic in thinking about shooting spikes. You should be familiar with bigger-bell-curves-are-better-logic from Part II:

1. The more mature bucks you have, the bigger the bell curve of mature bucks, and the more 160+ bucks you will have.
2. The size of the bell curve of mature bucks—i.e. the number of mature bucks—depends on the number of buck fawns put on the ground.
3. If you shoot yearling spikes, you reduce the number of mature bucks in later years which results in a smaller bell curve and smaller numbers of top end bucks.
4. So why would anyone shoot spikes?

The following bell curves illustrate this bigger-bell-curves-are-better-logic. For this exercise I assume a) 250 bucks fawns on the ground each year (the high density case on 5,000 acres described in Part II), b) 50% of yearlings are spikes, and c) a manager shoots 75% of the yearling spikes. After accounting for natural mortality and assuming average nutritional conditions, shooting spikes results in 4.6-160+ bucks versus 7.3 160+ bucks with no spikes harvested (or 1.59 times more 160+ bucks).



In the above bell curve, shooting 75% of yearling spikes produces 4.6 bucks that score 160+. The bell curve below predicts that a manager would have 7.3-160+ bucks if he shot no spikes.



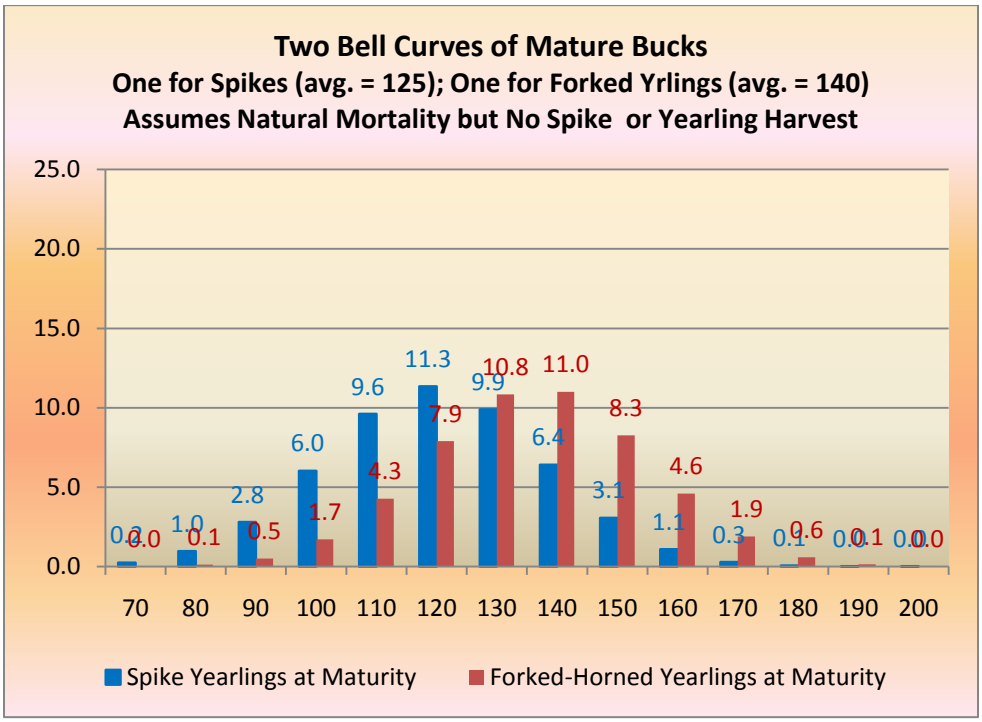
If a manager shoots 75% of the yearling spikes (assuming 50% of all yearlings are spikes), the bigger-bell-curves-are-better-logic predicts 4.6-160+ bucks at maturity versus 7.3-160+ bucks if one does not shoot spikes. Since 7.3-160+ bucks is better than 4.6-160+ bucks, a manager hurts himself by shooting spikes—at least using the bigger-bell-curves-are-better-logic explained in Part II.

But as I thought more deeply about the spike question, I came to realize that the bigger-bell-curves-are-better-logic is flawed with regard to shooting spikes.

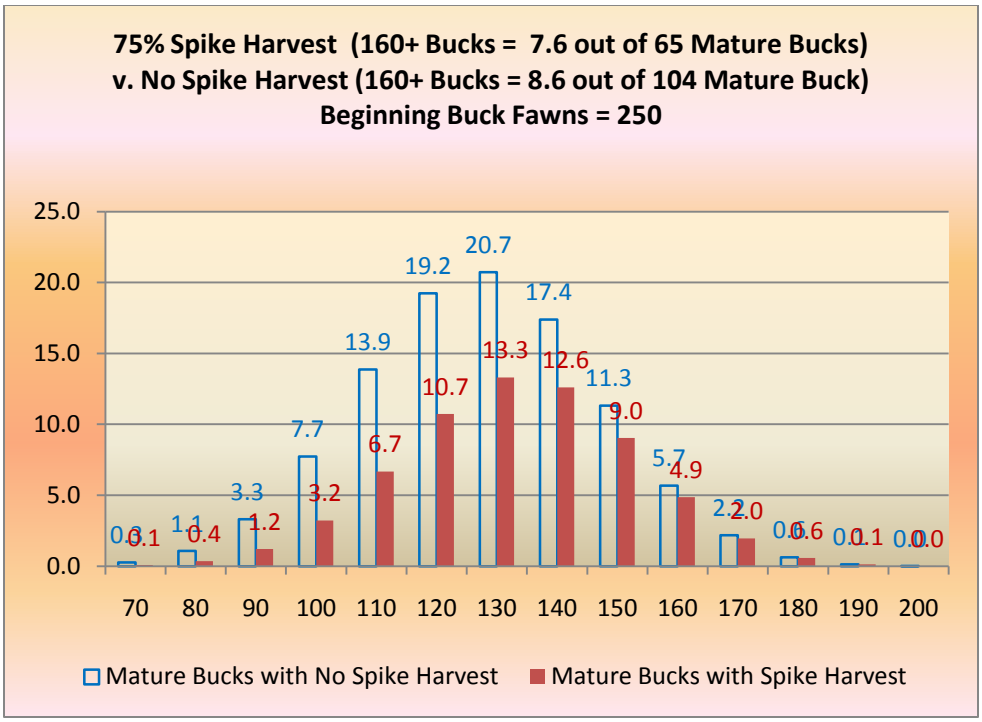
To better understand the impact of shooting spikes, I reviewed John S. Lewis's Ph.D. dissertation of December 2010 in which he analyzed the results of a Caesar Kleberg Institute yearling recapture study. From October 1998 to October 2007 Dr. Lewis captured 825 known-aged yearlings on 5 ranches in South Texas. He then recaptured them in subsequent years as they matured. He recaptured 29 mature (5 ½ years and older) bucks that had 3 or fewer points as yearlings; and he recaptured 24 mature bucks that had 4 or more points as yearlings. His analysis of the data showed that the average B&C score of yearlings with 3 points or less was 125 whereas yearlings with 4 points or more had an average B&C score of 140.

The light bulb went on when I read this: THERE ARE 2 MATURE BUCK BELL CURVES--one for yearling spikes and 3-pointers, the other for yearling 4 pointers and more.

Armed with Dr. Lewis's results, I used bell curve analysis—and its predictive statistical power—to tackle the spike question. Assuming no harvest of yearlings at all, these twin bell curves of mature buck scores—one for yearlings that were spikes, the other for yearlings that were forked-horned—looks like this:



So let's assume (as I did in the bigger-bell-curves-are-better analysis) that a spikes make up 50% of all yearlings and that a manager harvests 75% of all spikes. Shooting 75% of all yearling spikes results in 7.6-160+ bucks versus 8.6-160+ bucks with no spike harvest at all as shown in the following graph:



The two bells curves in the above graph tell the tale. The blue bell curve—mature bucks with no spike harvest—is in fact bigger (more bucks) but the average score is lower (133). The red bell curve—mature bucks with a 75% spike harvest—is smaller but the average score is much higher (137.5).

What do I conclude from this analysis? Yes, harvesting spikes results in fewer top end bucks at maturity (7.6-160+ v. 8.6-160+), but the impact is not as catastrophic as predicted by the bigger-bell-curves-are-better analysis (4.6-160+ v. 7.3-160+). In other words, you can harvest spikes and still produce a good number of top end bucks at maturity because of the two bell curves at work—a lower average one for spikes, a higher average one for forked-horned yearlings.

CAVEAT: For a manager to experience the results outlined above, he really must have a high fence. Yearling bucks disperse several miles from where they were born. Even if a manager harvested 75% of the spikes on his ranch, other spikes would move into the area absent a high fence.

Do I shoot spikes? No, but this bell curve analysis makes me realize that the impact is not as negative as my initial bigger-bell-curve-is-better logic would predict. So why don't I start shooting spikes?

1. My goal is to raise giants (200+ bucks and bigger). Even if the spike bell curve lies well to the left of the forked-horned bell curve, one of those spikes could in fact become a giant. The odds of a spike becoming a giant are lower than a forked-horn yearling becoming a giant but it is very possible statistically. So I will continue to wait until 4 ½ years of age to begin culling.
2. The few deer breeders I have spoken with about this issue tell me that they do not cull spikes; rather, they wait to cull until older ages. They should know; besides, the consequences to deer breeders of culling a future giant are catastrophic. Although this evidence is purely anecdotal, this practice buttresses my instinct to let the odds—even though smaller—play out and watch a buck's antlers develop.

3. Our guests really like shooting mature culls. I do not think they would get the same thrill out of shooting spike-antlered yearlings.

When would harvesting spikes make sense? Two situations are compelling.

1. To keep feed costs down. Harvesting spikes is a great way to keep your feed cost down since it reduces the number of bucks carried until maturity. If managing feed cost to a manager is as important as raising giants, I think the low odds of killing a spike that might become a giant makes spike harvest a compelling way to reduce feed cost.
2. Consistently high fawn survival. At the arid Faith Ranch in southwestern Dimmit County, fawn survival in fed pastures averages about 75% but ranges from 40% to 125%. Our buck numbers are high (we stack mature bucks; see *Magic of Stacking* – October 2009 eNews) but manageable. But in higher rainfall areas such as the Hill Country, fawn crops on intensely fed ranches are more consistent and can average 125% or more. In those environments, you can end up producing a ridiculous number of bucks. Yes, a manager of a ranch with super high fawn survival can control his population by carrying very few does, but extremely low numbers of does might not produce the desired number of *buck fawns on the ground* in extended droughts. Instead of controlling the population solely through the doe harvest, harvesting spikes would be a low risk way of keeping herd numbers reasonable. Spikes have the advantage of being known age (almost always yearlings) and—on average—will not grow antlers as large as forked-horn yearlings. In contrast, trying to cull at 3 ½ injects aging error into the culling decision and one can end up taking a magnificent 2 ½ year old that appears on the hoof to be 3 ½. Shooting spikes on a super high fawn crop ranch eliminates that aging error and provides a low risk way controlling buck numbers.

Spikes and Genetics

Notice I have not yet mentioned shooting spikes to achieve genetic improvement of the herd. I actually do not believe spikes are genetically inferior. This debate still rages on in some circles, but this issue is well beyond the scope of this article.

But you must be clear on this important point: Dr. John S. Lewis's research does NOT show that spikes are genetically inferior. Yes, he found that a group of spikes at maturity will have a lower average B&C score than a group of forked-horn yearlings. Yet he did not have any way of knowing whether the yearlings grew only spikes because of genetic inferiority or because of environmental influences. I will discuss environmental influences more fully in Part IV of this series, but there is no question in my mind that a buck's early environment—health of the mother, age of the mother, timing of birth, range conditions shortly after weaning, the presence of supplemental feed, the distribution of that feed, the percentage of a particular doe's diet from supplemental feed (a percentage that varies from doe to doe), and the percentage of supplemental feed consumed by the yearling itself—greatly impact the antler potential of a buck throughout its life. In my view, environmental influences, not genetic inferiority, create most spikes.

Evidence from the TP&W Kerr Research study suggests that spikes are in fact genetically inferior. Others have questioned the validity of that conclusion. I am in the latter camp. But if you believe that spikes are genetically inferior, my bell curve analysis shows that the cost of an aggressive harvest of spikes (assuming 50% of yearlings are spikes and a manager shoots 75% of the spikes) is low. But BE CAREFUL and pay attention to the percent of yearlings in your herd that are spikes. If 100% of your

yearlings are spikes and you shoot 75% of them, you will not have many top-end bucks (and certainly not many mature deer). In fact, once the percentage of spikes rises about 80%, a harvest of 75% of the yearling spikes starts cutting into top end potential.

Summary of the Deeper Dive Into Bell Curve Analysis

Part III's deeper dive into bell curve analysis illustrates the impact of an intense culling program on the bell curve. Intense culling for 3 years simply lops of the left end of the bell curve. But if a manager stops culling after 3 years, younger age classes—the antlers of which are distributed in a bell curve—enter the mature age classes so that the bell curve at the end of year 6 ends up where it started before culling began. Part III also explored the spike question and used Dr. John Lewis's Caesar Kleberg Institute study to generate two bell curves—one with an average of 125 for spikes and one with an average of 140 for forked-horn yearling. Because more leftward position of the spike bell curve, shooting spikes reduces slightly the total number of 160+ bucks at maturity (at least assuming 50% of spikes are yearlings and the spike harvest is 75%), but the impact is not severe.