Proceedings, The Range Beef Cow Symposium XXII
November 29, 30, and December 1, 2011, Mitchell, NE

Cow Side of Producing a 1,000 lb. Feeder, Cow Size And Expenses

Ken Olson[1], Justin Waggoner[2], and John Jaeger[2]

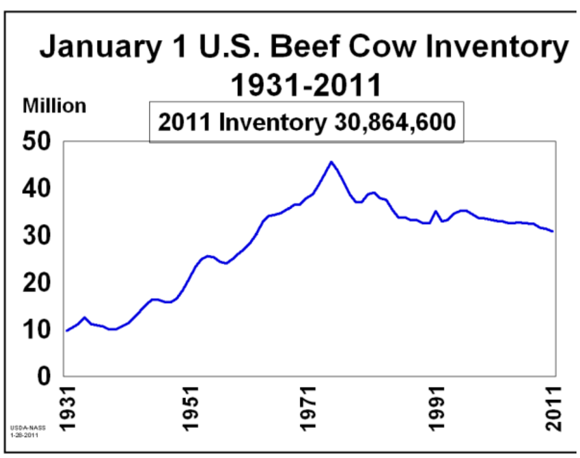
[1]Dept. of Animal Science, South Dakota State University and
[2]Dept. of Animal Science and Industry, Kansas State University

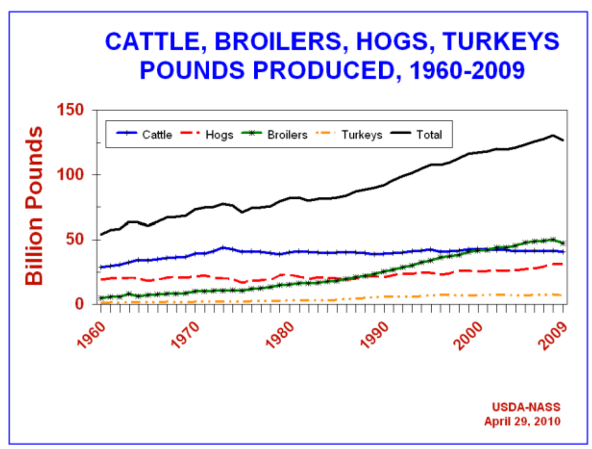
Introduction

Do relationships exist between cow size, nutrient requirements, and production capability? We can assume that a bigger cow will require more nutrients. What are the characteristics of that relationship? Is it a direct response wherein a cow that is 10% bigger than another will require 10% more nutrients, or is there economy of scale, so to speak? Can we assume that a bigger cow will be more productive? Is it automatic that bigger size means faster growth so we can expect the calves of bigger cows to grow faster? We will explore these relationships.

Cow Size

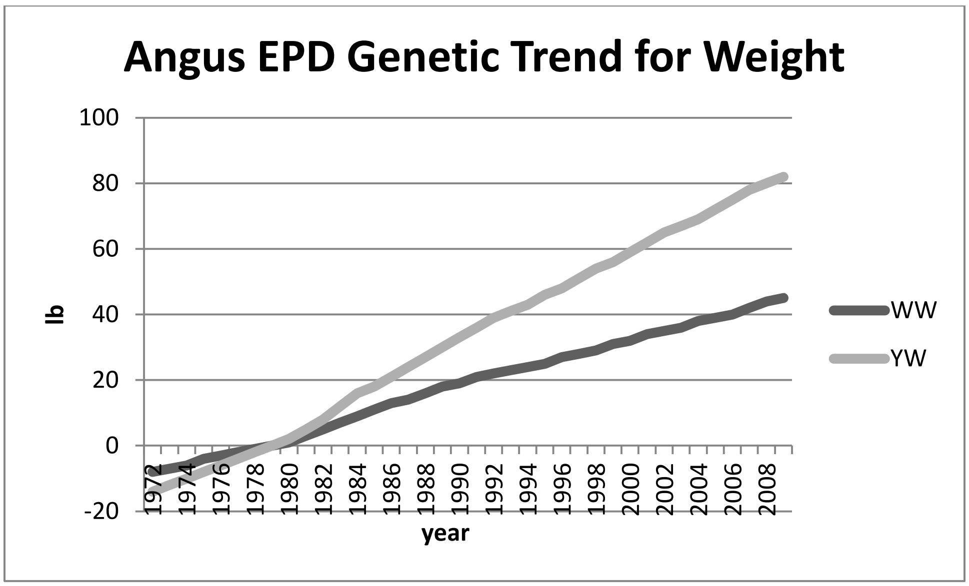
It is commonly understood that cows are getting bigger. When one considers that the cow population in the US has shrunk since 1974 (as depicted in the cow inventory figure below) while total pounds of beef produced annually has been maintained at nearly 50 billion lb over the same time period (as depicted by the line depicting lb of cattle produced in the various meat sources figure), it is obvious that cattle have had to steadily increase growth potential and size.





Perhaps the more important question is how big is the modern cow? More particularly, each of you might wonder how big your cows are. If everyone had a scale on the ranch, this would be known. Perhaps the best alternative on a ranch-specific basis is to look at sale weights of cull cows and then try to adjust for any differences between the culls and the cows that remain in the herd.

In place of thinking specifically of each ranch, let's look at indicators of cow size in general. One indicator is the shift in EPD genetic trends for cattle weights. As depicted in the following figure, the genetic trend through time for the Angus breed has displayed a steady increase in weaning, yearling, and mature cow weight. In particular, yearling weight, which is considered a reliable indicator of mature weight, has increased by 96 lb over the span represented in this graph. We can expect that an increasing trend has occurred in other breeds as well.



Another source of information about mature cow weights is the USDA Germplasm Evaluation Program being conducted at the Meat Animal Research Center near Clay Center, Nebraska. Based on direct head-to-head comparison of cow weights from several sire breeds, they report the following mature weights using 2009 data:

Breed	5-year-old weight, lb
Hereford	1419
Angus	1410
Red Angus	1409
Simmental	1404
Gelbvieh	1323
Limousin	1391
Charolais	1371

These weights suggest two things. First, the average cow weight across all breeds shown here is 1390 lb. Second, there is difference among breeds. Our perception of which are the "big" breeds may not be supported by these data. British breeds have surpassed continental breeds in mature cow size. That may be a function of genetic trends that are changing the size of cows in each breed at different rates. Thus, the breeds that produce big cattle may be changing.

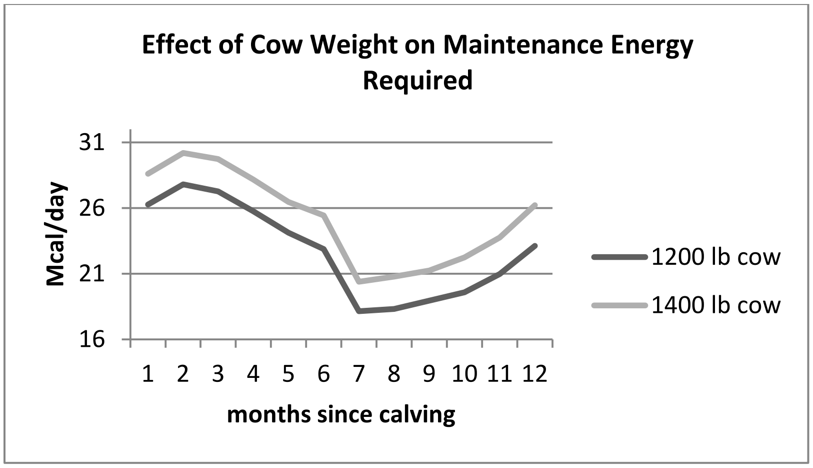
Finally, a third way to estimate mature cow size is to evaluate weight of finished offspring. The general rule of thumb is that mature cow weight and live weight at slaughter of their progeny should be similar. Again, USDA Meat Animal Research Center data supports this relationship. In 1990, average market weight for slaughter cattle was 1180 lb; and it had increased to 1343 lb in 2009. This implies that mature cow weight has increased by 163 lb over the last 19 years.

Cow Size and Nutrient Requirements

It is a fact that nutrient requirements increase as the size of an animal increases, but is it a straight-line, direct relationship? For mammals in general, nutrient requirements per lb of body weight increase at a decreasing rate. Said another way, the nutrient requirements per lb are lower for a large animal than for a small animal. This is particularly true for the requirement for energy. Basically, nutrient requirements rise more directly as a function of surface area of the animal than body weight, and surface area increases at a lower rate than weight does, i.e. the surface area per lb is much less for an elephant than a mouse. This relationship is described mathematically based on the basal metabolic rate, which is essentially the rate of energy consumption for an animal to maintain itself (i.e. energy of maintenance). The mathematical relationship is that net energy for maintenance (NE_m) rises as a function of body weight to the ¾ power. This is the basis for calculating the energy requirements for domestic livestock species. The equation for NE_m for beef cattle (NRC, 2000) is:

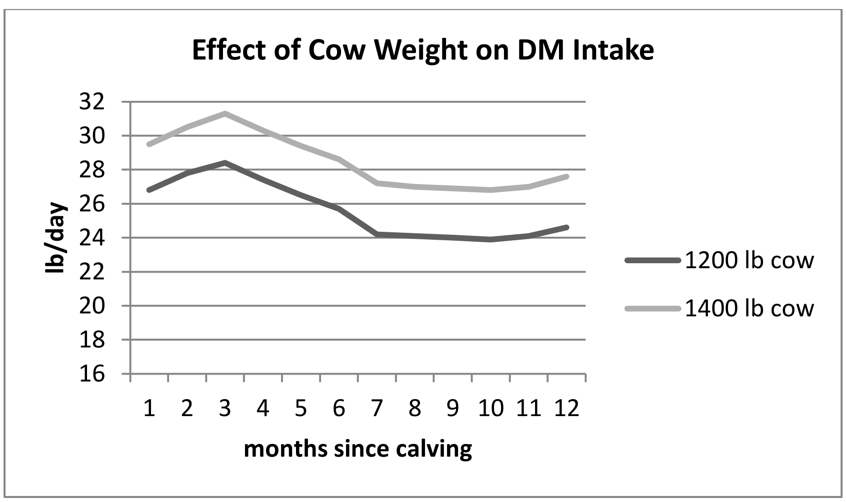
$$NE_m = 0.007 \text{ Mcal/BW}^{0.75}$$

The practical importance of this is not the specifics of this equation, but the results that it provides when we calculate the nutrient requirements of a cow so that we can balance a ration to meet her energy requirement. Modern computerized ration balancing programs take care of the particulars of the math for us. It is important to realize that this relationship causes a dramatic difference in the energy requirements of animals with vastly different sizes, as in a mouse vs. an elephant. Within the range of variation within a particular species, i.e. cattle, it is less dramatic, but still exists. The maintenance energy (ME) requirement (based on NRC, 2000) for two different sizes of beef cows is depicted in the following figure:



The ME required by the 1400 lb cow is about 11% higher than that required by the 1200 lb cow, despite the fact that she is about 16% heavier.

The final question about nutrient requirements is how do we get the additional nutrients into the larger cow using similar resources to those that were used for smaller cows in the past (i.e. the rangeland on your ranch)? The nutrient densities of the forages are about the same, so forage intake needs to increase. Continuing with the same example using 1200 vs. 1400 lb cows, forage intake will need to be:



Annual dry matter intake will be 9353 lb and 10,406 lb for the 1200 and 1400 lb cows, respectively. This is a difference of 1053 lb, or about an 11% increase for the larger cow.

Production Capability

Bigger cows have to eat more, so they have to produce bigger calves to cover their additional feed costs. We can calculate how many more lb of weaned calf will be needed to compensate for the additional feed consumption by the cow. To do this, we divide the annual feed consumption by the potential calf weaning weight to determine the equivalency in lb of calf weaned per lb of forage consumed:

Feed consumed per lb. weaned

Cow wt., lb.	Annual DM intake, lb.	Weaning weight, lb.			
		500	550	600	650
1200	9,353	18.7	17.0	15.6	14.4
1400	10,406	20.8	18.9	17.3	16.0

Note that this measure of "feed efficiency" is about equivalent on the diagonal where weaning weight is 50 lb. greater for the 1400 lb. cow vs. the 1200 lb. cow. Thus, for every 200 lb. increase in cow mature weight, one needs about a 50 lb. increase in weaning weight. Producers will need to evaluate performance trends of their cow herd and genetic potential of future sires to determine if this can be attained.

The next question is whether this is a reasonable expectation. One way to evaluate this is to reconsider the Angus EPD genetic trend for weaning weights depicted earlier. If we assume that cows increased in size from about 1200 to about 1400 over the last 20 years (1990 to present) as suggested earlier, then we can look at the trend for the weaning weight EPD from 1990 to present. That trend has increased by 26 lb from 1990 to present, suggesting that the genetic potential for a 50 lb increase in weaning weight is not available. As a disclaimer, we are not criticizing the Angus breed. We have simply used them as an example. This exercise could be completed for many of the popular breeds in the US, and we suggest that the results would be similar. Additionally, using an overall breed trend does not indicate the potential for improvement in specific herds.

What we think this means is that other management factors need to be improved (and probably have been over the last 20 years) to gain at least a 50 lb increase in weaning weights. Among these are better grazing management, range improvements, strategic supplementation, and alternative management strategies such as adjusting calving and weaning dates to change nutrient demand by the cow-calf pair.

Matching your Cattle to Your Environment

Let's move on to the next question: does a cow's larger size and genetic potential affect her ability to meet her nutrient requirements from grazing? In other words, does she match her environment?

Given that larger size and higher milk production increase nutrient requirements, the most important characteristic of the environment to match cows to is the nutrient supply that the forage provides. Range and pasture grazing resources vary tremendously in amount of forage and level of nutrition in the forage. Thus, cow biological type (size, growth potential, milk production, etc.) needs to be matched to local grazeable forage resources.

Extremes in biological type seldom match, and intermediate types are usually most efficient. For example, a study was conducted by Don Kress and others in northern Montana (Kress, 1993) in the 1980s and 90s that compared 5 breed combinations that progressively increased genetic potential for growth, size, and milk production:

1. Straightbred Herefords
2. Angus X Hereford
3. ¼ Simmental X ¾ Hereford
4. ½ Simmental X ½ Hereford
5. ¾ Simmental X ¼ Hereford

As one would expect, the progression to greater potential lead to larger weaning weights. However, weaning weight per cow exposed (WW/CE), which incorporates reproductive performance by the cows with growth of the calves, changes the story. Cows in group 5 could not harvest enough forage to meet their nutrient requirements so their pregnancy rates were lowered to the point that their WW/CE was lower than the intermediate groups. Thus, groups 1 and 5, the extremes, had the lowest WW/CE. Economic analyses indicated that profitability was closely reflected in WW/CE.

Additionally, scarce or abundant forage resources move the best biological type toward the extremes, but not to the limit. A similar study was conducted by Ag Canada in the same era. They used 2 locations, one each with abundant and scarce forage resources. In this study, the breed combination supporting the highest WW/CE was a larger and greater milk producing biological type than the optimum type for the scarce resource location. However, in neither case was it the most or least productive breed combination.

Additionally, risk (magnitude of lost WW/CE because of choosing the wrong level of cow size and productivity for the environment) was greater in poorer forage conditions. In other words, making a mistake in choosing the best biological type had greater consequences in poorer forage conditions.

What does this mean? Allowing mature cow size to increase without managing it can lead to cows that will be challenged to be productive under a given set of forage resources. If cows are too big, they will struggle to remain reproductively sound unless additional, harvested feed resources are provided. The cost of these feeds will further exacerbate the need for those larger cows to produce enough additional lb. of weaned calf to pay their feed bill.

Does your stocking rate fit your cow size?

These studies were done using conservative stocking rates so that forage availability was as good as it was going to get for the local environment. What would happen if the pasture were stocked heavily so that forage was limited?

The answer is obvious, cattle performance would suffer. There are dozens of grazing research experiments from throughout the world that show that livestock performance declines as stocking rate goes up. If you will, this can be likened to a feedlot setting wherein a pen that was designed to hold 100 feeders gets 20 extras placed in it, but there is no additional bunk space and no additional feed is placed in the bunk. This group of 120 head will be short of feed and will perform in proportion to what is available. The same thing happens in a pasture setting; there is a finite forage supply in a finite amount of space, and additional mouths compete with each other for what is available.

Stocking rate is how we adjust the amount of "bunk space" and "feed in the bunk" for grazing cattle. Unfortunately, it is not as easy because we don't get to weigh the "feed" per se. Instead, we allocate a certain acreage based on the concept that more or less acres per cow yields more or less forage for her to consume.

Now consider that feed calls are adjusted for the pen of steers in the feedlot so that adequate feed is placed in the bunk at each delivery. As the steers get bigger and feed disappears more rapidly, the bunk reader makes a call for more feed. Unfortunately, if cows are getting bigger, but the number of acres and therefore the amount of feed allocated per cow remains the same, then we have the equivalent of adding steers to a pen but not putting more feed in the bunk.

The point is, it is important for a producer to manage this relationship between cow size/forage requirements and pasture allocation/forage supply. It is important to know the size of cows and adjust stocking rate appropriately if we really want the cows to be able to consume enough feed to fulfill their genetic potential for production.

Simply put, if cows weighed 1200 lb. in the past and they now weigh closer to 1400 lb., that is a 17% increase in size and an 11% increase in forage intake. Therefore, those cows should get a similar increase in pasture allocation (adjusted stocking rate), or pasture productivity needs to have increased in a similar proportion.

The bottom line is that production systems need to be considered in an integrated approach. As we make adjustments to genetics, we need to consider the ramifications on all other aspects of the operation, including range management and feed/nutrient supplies, if we want the system to be productive and profitable.

Conclusions

The bottom line that can be drawn from this discussion:

1. Cattle have changed dramatically over the last 2 or more decades:
    a. Cows are bigger; probably 200 lb bigger than 2 decades ago.
    b. The reason cows have gotten bigger is genetic selection for increased rates of growth, which leads to larger size.
2. Bigger cows take more feed to meet their nutrient requirements.
3. Bigger cows need to wean bigger calves to pay for the increased feed costs.
4. Improved management needs to provide increased opportunity for cows and their calves to achieve the increased production needed to overcome the increased feed costs.

Literature Cited

Kress, D.D. 1993. Matching cattle to forage resources. Pp. 11-19. In: Proc., Matching Beef Cattle to Western Environments Symposium. Phoenix, AZ.

NRC. 2000. Nutrient Requirements of Beef Cattle. 7th revised ed. Natl. Acad. Press, Washington, DC.