Mature Cow Size Considerations

March 2018

Aksel Wiseman
Graduate Research Assisant

David Lalman
Professor, Beef Cattle

Eric DeVuyst
Farm and Production Management Specialist

Introduction

Dramatic swings in mature size of cattle have occurred in the U.S. beef industry since the 1930s. Pictured below are champion animals selected at major U.S. livestock shows in 1953, 1989 and 2014. One factor contributing to these dramatic swings over time is the high degree of heritability associated with mature frame size. For example, during fall 2017, heritability of mature height in the Angus breed was reported as 0.62, representing the highest heritability value among all 21 traits for which expected progeny differences were calculated. Not surprisingly, there is a strong genetic correlation between mature height and mature weight (0.76). Said another way, and as our history has proven, rapid and dramatic change can be made in mature cow size (height and weight) if enough selection pressure is applied in a given direction.

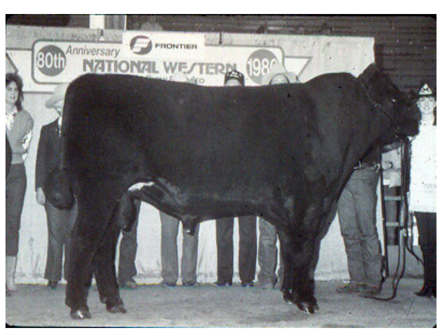
Consider that each 100 pounds of additional mature cow weight requires the equivalent of about 600 pounds of additional high-quality grass hay per year to maintain their body weight and condition (NASEM, 2016). Consequently, feed costs and forage requirements will be impacted by mature cow size. Even though the optimal phenotype for this characteristic has been debated for many years, it continues to be an import consideration because of the impact it can have on ranch profitability, appropriate stocking rate and consumer acceptance of beef products.

Cow Size

Currently, mature frame size in the U.S. beef cattle industry could be described as moderate and consistent. In fact, the genetic trend for mature height in Angus cattle has not changed since 1992 (American Angus Association, 2018). Using cow carcass weights as a barometer, mature cow weights increased rapidly from the early 1990s through about 2004. Since that time, change in annual average cow carcass weights has slowed and appears to be stabilizing (Figure 1). Similarly, the genetic trend for mature cow weight in the Angus and Hereford breeds indicate a gradual, although slowing increase through time (American Angus Association, 2018; American Hereford Association, 2018). Interestingly, the Red Angus mature cow weight genetic trend increased consistently from 1970 through about 2003. Since then, Red Angus mature cow weights have trended down (American Red Angus Association, 2017).

Changes in weight with no change in frame size suggests modification over time in body composition. For example, most breeds' genetic trend data indicate that carcass weights, muscularity (reported as longissimus muscle or rib-eye-area), and to a lesser degree, back fat are increasing over time. At the same time, consistent selection for growth in most breeds, combined with little to no selection pressure against feed intake (until just recently), has led to a U.S. beef cattle population with increased capacity for feed intake.

It is unknown whether genetic changes over the past 30 years have led to increased feed intake when expressed as a percent of the cow's body weight. Generally speaking,



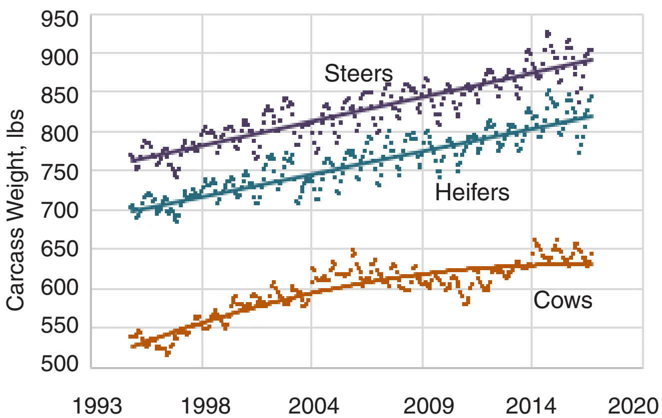


Figure 1. Carcass weight trends for federally inspected steers, heifers and cows (USDA AMS).

greater appetite is associated with increased visceral organ mass. That is to say cattle have larger organs, particularly liver, rumen and intestines than they used to have. Visceral organs are expensive tissue to maintain. Therefore, one might conclude that from an industry-wide perspective, the annual cost to maintain a beef cow of the same weight (or the amount of grazing land required) could be gradually increasing. Determining the relative value of increased growth, carcass weight and feed intake compared to the increased cost, particularly during the cow/calf phase of production, is a difficult and complicated task.

Output Considerations

In an attempt to quantify the relationship of mature cow weight to calf weaning weight in commercial cow/calf operations, researchers at Oklahoma State evaluated 3,041 records collected from three different operations (Bir et al., 2018). In the data set, cow weights ranged from 635 to 1,922 pounds and calf weaning weight ranged from 270 to 775 pounds. First of all, there was not a strong relationship between cow size and calf weaning weight (Figure 2). In other words, there was a lot of variation in weaning weight, and cow size explained only a small portion of this variation. In almost any cow herd, there will be small cows that are individually efficient (relatively high weaning weight for their mature size) and there are large cows that are individually efficient.

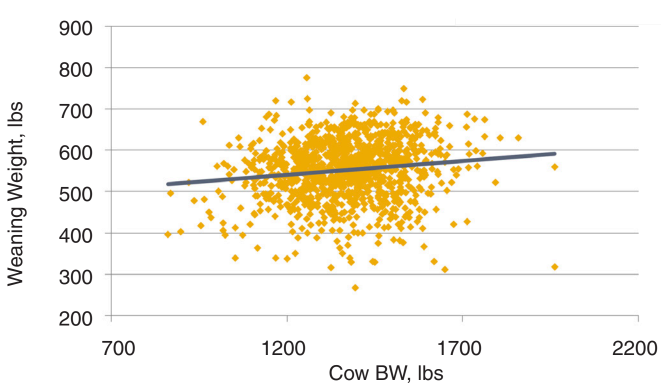


Figure 2. Relationship of mature cow weight to calf weaning weight in commercial beef cow/calf operations (Bir et al., 2018).

Although the relationship was not strong, it was statistically significant and positive. It was determined that for each 100 pounds of additional cow weight, calf weaning weight increased by an average of 6.7 pounds. Arkansas data published in 2016 (Beck et al. 2016) indicated that this relationship was 19 pounds of added weaning weight for each 100 pounds of additional cow weight. More recent data from North Dakota (Ringwall, 2017) documented a 28-pound increase in calf weaning weight. Climate and management practices likely have substantial impact on this relationship. Without solid evidence, cows in a challenging environment will likely wean less calf weight per added 100 pounds of cow weight, perhaps closer to 6 pounds. In less restrictive environments, the relationship will likely be at the upper end or closer to 28+ pounds per 100 pounds of cow-added cow weight. “Less restrictive” can be interpreted as higher quality, more abundant forage, lower stocking rate (allowing the cattle to select a better quality diet), more harvested forage feeding, more supplementation, more winter annual grazing, less heat or cold stress, less parasite exposure and so on.

Based on the evidence available; it appears that each additional 100 pounds of cow weight generates about $6 to $30 of added calf income, depending on the calf market. However, in a 2011 study, the addition of each 100 pounds of cow weight cost an additional $42 due to increased feed costs and grazing land required (Doye and Lalman, 2011). To take this a step farther, in several published economic evaluations of varying cow size and a given land resource, smaller and moderate cows have a financial advantage for three primary reasons: 1) higher stocking rates for smaller cows result in more pounds weaned per acre; 2) lighter calves sell for a higher price per cwt; and 3) the increased revenue from added weaning weights do not offset the higher feed costs of larger cows (Bir et al., 2018). Obviously, items 2 and 3 in this list assume little to no market discount for smaller-framed calves that may have lower growth rate and likely have lighter carcass weights.

Larger mature cow size generates more cull cow income, and this is considered in previously mentioned economic evaluations. One factor often overlooked when crediting larger cows with increased cull income is additional cow weight is not free to begin with. For example, comparing 1,000-pound cows to 1,400-pound cows and a $70 per cwt cull cow price, 1,400-pound cows generate an additional $280 at culling time. However, the additional 400 pounds of growth required additional nutrients through the development stages and about six to seen years of age when they finally reach their mature weight. While forage is generally the cheapest feed resource on a ranch, the conversion of forage (even high quality forage) to cow weight gain is low. Consequently, the increased cull cow income will be substantially offset by the economic cost (although nearly impossible to measure) of developing or growing the added cow weight.

Cow Size v.s. Carcass Weight

Carcass weights along with genetic potential for growth and economical regional post-weaning production systems may help establish logical minimum cow size. Carcass weight explains a large portion of variation in finishing cattle profitability (Gadberry and Troxel, 2006). However, there is a strong relationship between mature cow size and carcass weight

(Nephawe et al., 2004). Therefore, in general, selection for increased carcass weight will also lead to increased mature cow weight. Currently, maximum carcass weight allowed before price discounts are applied is around 1,000 to 1,050 pounds. Consequently, cattle feeders manage animals to minimize carcass discounts, which means they market them when carcasses average around 800 to 900 pounds.

Lower carcass weights, in general, reduce profit potential during the finishing phase (Tatum et al., 2012). Therefore, consideration should be given to the most likely post-weaning production system for a set of calves. Lancaster et al., 2014 summarized data from 29 different experiments. These researchers established that 94 percent of the variation in carcass weight could be explained by stocker-phase average daily gain and finishing-phase entry weight when cattle were fed to a constant rib fat endpoint. Slower stocker-phase rate of weight gain resulted in heavier carcass weight and heavier finishing-phase entry weight resulted in heavier carcass weight. Consequently, a longer stocker-phase period combined with slower or modest rates of gain will result in heavier finishing-phase placement weights and larger carcasses for cattle of smaller mature size.

Grazing Land Resources and the Environment

As shown in Table 1, heavier cows are expected to consume more feed/forage. In fact, a 1,500-pound cow should consume around 8 pounds more dry matter per day compared to a 1,000-pound cow. Assuming native rangeland pasture producing about 4,000 pounds of forage per year and a 25 percent harvest efficiency, this equates to about four more acres required annually per head for the larger cows.

Beef cattle retain only about 20 percent of the nutrients they consume (NASEM, 2016). The remainder is lost in feces, urine, respiration and eructation. Greenhouse gas emissions include methane, nitrous oxide and carbon dioxide. Agriculture contributes about 8.0 percent of greenhouse gas emissions in the world, and enteric methane contributes 2.7 percent of that (EPA, 2016). Methane alone represents a loss of about 6.25 percent of total energy consumed. Therefore, selecting for more efficient cattle helps to lower the carbon footprint (methane, carbon dioxide and nitrous oxide), while improving efficiency of nutrient utilization and reducing cost of production. On an individual animal basis, methane and nitrogen emissions are greater in larger cows that consume more feed. However, when stocking rate is adjusted in a way that results in similar grazing pressure, methane and nitrogen emissions are similar regardless of cow size (Table 1).

Conclusion

Cow size is an important consideration in a ranching enterprise. Because mature frame size and weight are highly heritable traits, cow size can be, and has been, readily manipulated through selection. On average, frame size throughout the beef industry has moderated and has been consistent for several years. Just recently, mature cow weight appears to be stabilizing. Larger cows consume more feed on an individual basis and in many situations, marginal increased weaning weight and cull cow income are not adequate to pay for higher inputs due to increased cow size. Greenhouse gas emissions are greater for larger cows because they consume more feed. However, when stocking rate is adjusted for cow size, total ranch greenhouse gas and nitrogen excretion are similar.

References

American Angus Association. 2018. Genetic trend EPD/$ value by birth year http://www.angus.org/Nce/GeneticTrends.aspx. (Accessed: February 12, 2018).

American Hereford Association. 2018. EPD trends. https://hereford.org/genetics/breed-improvement/epd-trends/. (Accessed: February 12, 2018).

American Red Angus Association. 2017. EPD trends. http://redangus.org/genetics/epd-trends. (Accessed: February 12, 2018).

Beck, P. A., C. B. Stewart, M. S. Gadberry, M. Haque, and J. Biermacher. 2016. Effects of mature body weight and stocking rate on cow and calf performance, cow herd efficiency, and economics in the southeastern United States. *J. Anim. Sci.* 94:1689-1702.

Bir, C., E. A., E. A. DeVuyst, M. Rolf, D. L. Lalman; 2018. Optimal Beef Cow Weights in the U.S. Southern Plains. *J. Ag. Res. Econ.* 43(1):102-116.

Doye, D. G. D. L. Lalman; 2011. In: Annual Meeting, Ferbruary 5-8, 2011, Corpus Christi, Texas (No. 98748), 2011, Southern Agricultural Economics Association.

EPA. 2016. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2014. EPA 430-R-16-002. EPA. Washington, D.C.

Gadberry, M. S., and T. R. Troxel. 2006. Nine-year summary of Arkansas Steer Feedout Program: Factors contributing to value and return. *Prof. Anim. Sci*. 22:452-462

Table 1. Grazing costs and excretion values with varying mature cow size.

Cow Weight, lbs	*1,000*		*1,250*		*1,500*	
	Individual	*Total Herd*	*Individual*	*Total Herd*	*Individual*	*Total Herd*
Daily DMI, lb	22.34	3,017	26.41	3,037	30.29	3,029
Annual DMI, lb	8,154	1,100,790	9,640	1,108,600	11,056	1,105,600
Relative cow #'s	1	135	1	115	1	100
Forage cost, $/cow	$220.16	$29,721.60	$260.28	$29,932.20	$298.51	$29,851.20
Manure Output, lb/yr	3,419	461,565	4,082	469,430	4,713	471,300
Nitrogen excretion, lb/yr	88.2	11,907	104.4	12,006	119.6	11,960
Methane Emissions, lb/yr	167.2	22,572	198.7	22,851	230.8	23,080

Lancaster, P. A., C. R. Krehbiel, G. W. Horn. 2014. A meta-analysis of effects of nutrition and management during the stocker and backgrounding phase on subsequent finishing performance and carcass characteristics. *Prof. Anim. Sci.* 30:602-612.

NASEM (National Academies of Sciences, Engineering, and Medicine). 2016. *Nutrient requirements of beef cattle*. 8th rev. ed. Natl. Acad. Press, Washington, DC.

Nephawe, K.A., L.V. Cundiff, M.E. Dikeman, J. D. Crouse, L. D. Van Vleck. Genetic relationships between sex-specific traits in beef cattle: Mature weight, weight adjusted for body condition score, height and body condition score of cows, and carcass traits of their steer relatives. *Journal of Animal Science*, Volume 82, Issue 3, 1 March 2004, Pages 647–653,https://doi.org/10.1093/ansci/82.3.647

Ringwall, K. A., 2017. In: What is right for the beef business: A discussion on cattle size, September 2, 2017, Manning, North Dakota, World Cattleman's Cow Efficiency Congress.

Tatum, J. D., W. J. Platter, J. L. Bargen, R. A. Endsley. 2012. Carcass-based measures of cattle performance and feeding profitability. *Prof. Anim. Sci.* 28:173-183.

Research was conducted with a grant from U.S. Department of Agriculture, Project Nos. 2012-02355 and 2013-69002-23146 through the National Institute for Food and Agriculture's Agriculture and Food Research Initiative, Regional Approaches for Adaptation to and Mitigation of Climate Variability and Change.

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Director of Oklahoma Cooperative Extension Service, Oklahoma State University, Stillwater, Oklahoma. This publication is printed and issued by Oklahoma State University as authorized by the Vice President for Agricultural Programs and has been prepared and distributed at a cost of 20 cents per copy. 0318 GH.