BEEF CATTLE RESEARCH UPDATE

Britt Hicks, Ph.D., PAS
Area Extension Livestock Specialist
Oklahoma Panhandle Research & Extension Center

February 2016

Effect of Drought on Weaning Weight and Efficiency Relative to Cow Size in Semiarid Rangeland

Over the last several years, the trend in genetic selection for maximum growth (through the use of growth EPDs) has led to bigger, heavier cows.[1] Both feedlot close-out data (K-State Focus on Feedlots[2]) and USDA livestock slaughter annual summary reports (federally inspected carcass weight data[3]) suggest that the average weight of finished steers and heifers has increased approximately 200 to 225 lb since 1990. As a result of increased cow size, the amount of forage required per cow for maintenance has increased.

University of Wyoming researchers recently assessed the effect of cow size on weaning weight and efficiency in relation to drought on a semiarid high-elevation ranch in Wyoming.[4] In this study, calf weaning weights of 80 Angus × Gelbvieh cows from 2011 to 2014 were measured and the effects of drought on weaning weights, efficiency (calf weaning weight relative to cow weight), intake requirements, and potential herd sizes relative to cow size were assessed. Based on May 2013 cow weight, the cows were stratified into five weight classes (1000, 1100, 1200, 1300, and 1400 lb). Due to the differences in birth dates, birth weights, and weaning dates, and sex of the calves, weaning weights were adjusted to a uniform 210 day weight with an adjustment for calf sex. The 50 year mean annual precipitation at this ranch was 13.54 inches. The actual precipitation in 2011, 2012, 2013, and 2014, respectively, were 12.80, 7.91, 14.65, and 16.73 inches.

These researchers reported that regardless of cow size, the lightest calf weaning weights (WW) were in 2012 at 476 lb (Figure 1). The highest calf WW were in 2013 and 2014 at 551 and 564 lb, respectively, while calf WW were intermediate in 2011 at 516 lb. These differences can be explained by the drought and precipitation extremes in the 4-year study. The year with the lowest WW was 2012, the most severe drought year and the driest year in the last 50 years. The years with the highest WW, 2013 and 2014, represent two years of above-average precipitation and the least-severe drought conditions (2014 was one of the wettest years on record).

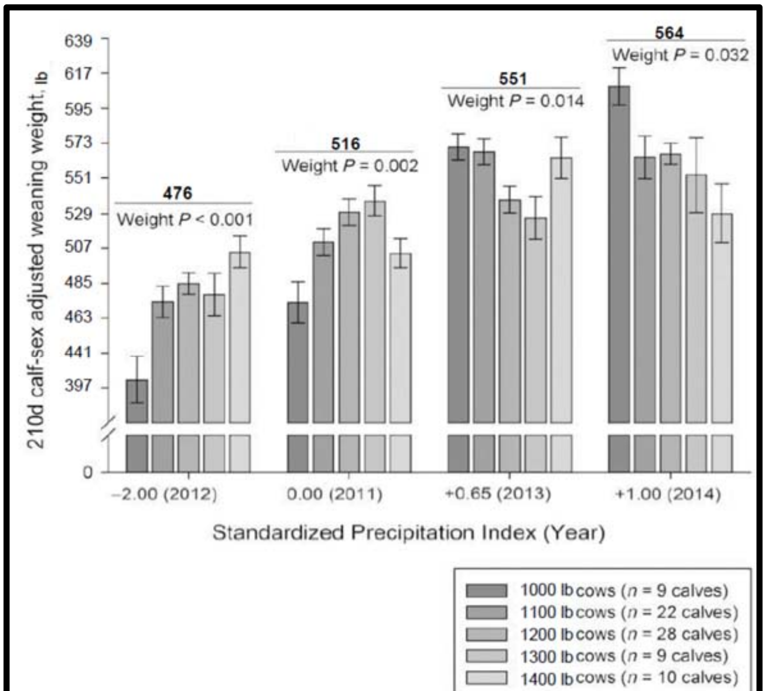

Figure 1. Effect of drought and cow weight on adjusted 210 day calf weaning weights from a semiarid and high-elevation ranch in Wyoming 2011 through 2014. Weight P-values indicate the significance of cow size in explaining intra-annual differences between weaning weights. Adapted from Scasta et al., 2015.

Cow size influenced WW each year ($P \leq 0.05$), but the effect was variable depending on precipitation conditions (Figure 1). In 2012, the driest and most severe drought year, as cow size increased, WW increased and the largest cows weaned the heaviest calves ($P \leq 0.05$). Whereas, the opposite trend was evident in 2014 (wettest year and least severe drought year) because as cow size increased, WW decreased and the smallest cows weaned the heaviest calves (P ≤ 0.05). In 2011, an average precipitation year, intermediate sized cows weaned the heaviest calves, but in 2013, a slightly wetter than average year, cows at the extremes (smaller or larger) weaned heavier calves than intermediate sized cows (P ≤ 0.05).

The effect of cow size on efficiency (calf WW expressed as percentage of cow weight) is shown in Figure 2. These data show that regardless of year or precipitation amount, the 2 smallest cow sizes (1000 and 1100 lb) always had significantly higher efficiency ratios than the two largest cow sizes. The efficiency of the smallest cows ranged from 41% in the driest year (2012) to 58% in the wettest year (2014). Whereas, the efficiency in the largest cows was always poorer ranging from 35 to 39%. The efficiency for the smallest cows was greater in the driest year (41%) than efficiency of the largest cows in the wettest year (37%). These authors noted that "this is an indication of the ability of smaller cows to lower maintenance requirements in response to changes in the production environment but with optimal upside potential when conditions are favorable".

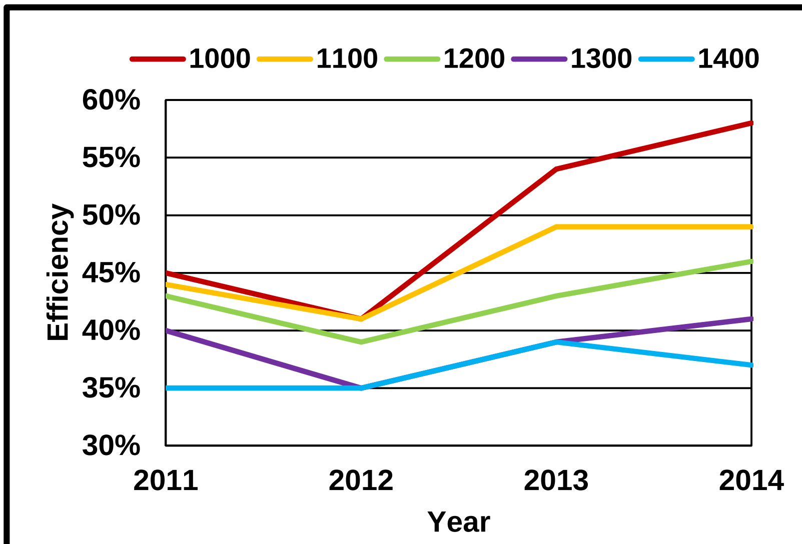

Figure 2. Comparison of mean efficiency (calf WW expressed as percentage of cow weight) by cow size class and year from 2011 to 2014. Efficiency for the smallest two cow sizes (1000 and 1100 lb) was always greater than efficiency for the largest two cow sizes (1300 and 1400 lb; P < 0.001).
Adapted from Scasta et al., 2015.

The classic definition of an animal unit (AU) that is commonly applied to public grazing allotments is a 1,000 lb cow with a calf.[5] Since larger cows require more forage for maintenance, these authors also calculated AU equivalents (AUE) based on metabolic requirements to determine daily forage intake by cow size class (Table 1). These AUE were then used to calculate the daily forage requirement based on a standard of 19.4 lb of biomass per 1 AU per day and the total forage intake over a 210 day birth-to-weaning period. They then used mean 4 year WW by cow size class to determine an input:output ratio using 210 day total forage intake based on metabolic requirements as the input and 4 year mean WW as the output (Table 1). This ratio can be interpreted as pounds of forage required for each pound of calf WW. Potential herd sizes were then calculated assuming herds were homogeneous in cow size based on unfavorable production scenarios using a 25% harvest use efficiency for a 6 month grazing season (Table 2). These adjusted herd sizes were then used to calculate total weight of the weaned calf crop using the 4 year average adjusted WW, the drought year (2012) WW, or the WW in the wettest year (2014).

As cow size increases, AUE based on metabolic requirements also increase (Table 1). In this study, the smallest cows had an AUE of 0.96 and the largest cows had an AUE of 1.23. This influences the amount of forage needed to meet maintenance requirements. Data in Table 1 shows that the smallest cows (1000 lb) required 7.6 lb of forage for each pound of calf weaned, intermediate size cows (1200 lb) required 8.4 lb of forage for each pound of calf weaned, and the largest cows (1400 lb) required 9.5 lb of forage for each pound of calf weaned. These data clearly illustrate that based on the 4 year mean WW that smaller cows consistently required less forage to produce a pound of calf than larger cows.

Table 1. Animal unit equivalents (AUE) and associated daily forage intake requirements based on mean cow weight for each size class and metabolic requirements. Input relative to output based on 4 year mean weaning weight (WW).

Cow Size Class	AUE	Daily Forage Intake, lb	Input: 210 day Total Intake, lb	Output: Mean Adjusted WW, lb	Input:Output Ratio: lb Forage:lb WW
1000	0.96	18.7	3,936	516.9	7.6
1100	1.03	20.1	4,214	528.3	8.0
1200	1.09	21.2	4,445	530.1	8.4
1300	1.17	22.7	4,769	524.1	9.1
1400	1.23	23.8	5,001	525.5	9.5

Adapted from Scasta et al., 2015.

Data in Table 2 shows that if the herd comprised all small cows (1000 lb), it should consist of 237 cows; whereas; if the herd comprised all large cows (1400 lb), it should consist of 186 cows (51 fewer cows). Based on the 4 year average WW for each cow size and probable cow numbers in each hypothetical herd, the smallest cow size would yield a total calf crop weight 24,255 lb greater than that of the largest cow size (122,382 vs. 98,127 lb). Based on the drought year (2012) WW for each cow size, the smallest cow size would yield a total calf crop weight 6,145 lb greater than that of the largest cow size in the worst conditions even when they wean lighter calves if herd size were adjusted (100,246 vs. 94,101 lb). Based on the wettest year (2014) WW for each cow size, the smallest cow size would yield a total calf crop weight 45,482 lb greater than that of the largest cow size in the best of conditions (144,103 vs. 98,621 lb).

Table 2. Tradeoffs related to cow size and weaning weight across years with a conservative stocking rates using unfavorable forage production values based on the average weaning weight across years, average weaning weight during the drought (2012) year, or average weaning weight during the wettest year (2014)

Cow Size Class	Total Cows for 6 month Season (difference)	Total WW, lb, based on 4 year mean WW (difference)	Total WW, lb, based on drought year mean WW (difference)	Total WW, lb, based on wet year mean WW (difference)
1000	237 (+29)	122,382 (+11,248)	100,246 (-1,458)	144,103 (+25,296)
1100	221 (+13)	116,850 (+5,715)	104,852 (+3,149)	124,847 (+6,039)
1200	208 (0 base)	111,134 (0 base	101,703 (0 base	118,808 (0 base
1300	196 (-12)	102,418 (-8,716)	93,499 (-8,205)	108,149 (-10,659)
1400	186 (-22)	98,127 (-13,007)	94,101 (-7,603)	98,621 (-20,187)
Range	51	24,255	11,353	45,482

Adapted from Scasta et al. 2015.

These researchers concluded that the results of this study indicate when conditions are optimal on semiarid high-elevation rangeland, small to moderate size cows are as productive as large cows in terms of calf WW and optimal in relative efficiency. Even though small cows weaned smaller calves in the drought year, smaller cows had higher biological efficiency, suggesting that per unit of production, smaller cows are more efficient and WW may not always reflect that advantage. Furthermore, these results indicate large cows (1300 to 1400 lb) do not maximize genetic potential in this production environment when conditions are optimum or provide any advantage over small or moderate size cows (1000 to 1200 lb) across the drought gradient.

[1] Johnson, J. J., B. H. Dunn, and J. D. Radakovich. 2010. Understanding Cow Size and Efficiency. In: Proceedings of the Beef Improvement Federation 42nd Annual Research Symposium, Columbia, MO. p. 62-70.

[2] Kanas State University Research and Extension. Focus on Feedlots. http://www.asi.k-state.edu/about/newsletters/focus-on-feedlots.

[3] USDA. Livestock Slaughter Annual Summary. https://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1097.

[4] Scasta, J. D., L. Henderson, and T. Smith. 2015. Drought effect on weaning weight and efficiency relative to cow size in semiarid rangeland. J. Anim. Sci. 93: 5829-5839.

[5] Scarnecchia, D. L. 1985. The animal-unit and animal-unit-equivalent concepts in range science. J. Range Manage. 38: 346-349.