FRAME SCORING BEEF CATTLE: WHY AND HOW

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INTRODUCTION

Frame scoring is a tool to evaluate the mature skeletal size of an animal. It is a scoring system that ranges from 1 to 10 based on height at the hips and adjustment for sex and age of the animal at the time of measurement. Most animals have the same frame score throughout their life, although extreme rates of growth caused by severe under- or over-nutrition can alter the trajectory of the growth curve as young animals grow to maturity. Frame scores can be used for a variety of management decisions. Because growth and size are moderately heritable traits, it can be used to adjust the mature frame size of a cow herd through genetic selection. Further, it can be used to manage the environment, particularly nutrition, to meet the needs and requirements of a given frame size of cattle.

Frame scoring and body condition scoring should not be confused. Whereas frame scoring is used to measure the skeletal frame of the animal, body condition scoring is used to evaluate the soft tissue (fat and muscle) cover over the frame of the animal to evaluate trend in nutritional status.

HOW TO MEASURE FRAME SCORE

The Beef Improvement Federation (BIF) recommends that hip height measurements used to calculate frame score be taken at the hip directly over the hook bones when the animal is standing on a firm, flat surface, legs symmetrically positioned, and head in a normal position. Hip heights can be determined with a hip height measuring stick or a tape measure that pulls down from above the animal.

The Beef Improvement Federation has developed charts for bulls and heifers from five to 21 months of age as well as mature cows and bulls. Tables 1 and 2 give current estimates of cattle height in about two inch increments at different ages; along with adjustment equations for bulls and females. Using the appropriate equation allows individuals to determine frame scores.

The equations to calculate frame score for animals between 5 – 21 months of age are:

Bulls Frame Score = -11.548 + (0.4878 x Hip Height) – (0.0289 x Age) + (0.00001947 x Age^2) + (0.0000334 x Hip Height x Age), where Age = days of age

Heifers Frame Score = -11.7086 + (0.4723 x Hip Height) – (0.0239 x Age) + (0.0000146 x Age^2) + (0.0000759 x Hip Height x Age), where Age = days of age

Additionally, BIF recommends measurement should be adjusted to weaning age (205 days) and yearling age endpoints (365, 452 or 550 days). Hip height measurement for

weaning age adjustment should be taken between 160 and 250 days of age. It is recommended that animals are at least 330 days of age prior to predicting yearling frame score measurements.

Table 1. Hip heights (inches) and frame scores for 5 – 21 month-old bulls and mature bulls

Age (months)	Frame Score										
	1	2	3	4	5	6	7	8	9	10	11
5	33.5	35.5	37.5	39.5	41.6	43.6	45.6	47.7	49.7		
6	34.8	36.8	38.8	40.8	42.9	44.9	46.9	48.9	51.0		
7	36.0	38.0	40.0	42.1	44.1	46.1	48.1	50.1	52.2		
8	37.2	39.2	41.2	43.2	45.2	47.2	49.3	51.3	53.3		
9	38.2	40.2	42.3	44.3	46.3	48.3	50.3	52.3	54.3		
10	39.2	41.2	43.3	45.3	47.3	49.3	51.3	53.3	55.3		
11	40.2	42.2	44.2	46.2	48.2	50.2	52.2	54.2	56.2		
12	41.0	43.0	45.0	47.0	49.0	51.0	53.0	55.0	57.0		
13	41.8	43.8	45.8	47.8	49.8	51.8	53.8	55.8	57.7		
14	42.5	44.5	46.5	48.5	50.4	52.4	54.4	56.4	58.4		
15	43.1	45.1	47.1	49.1	51.1	53.0	55.0	57.0	59.0		
16	43.6	45.6	47.6	49.6	51.6	53.6	55.6	57.5	59.5		
17	44.1	46.1	48.1	50.1	52.0	54.0	56.0	58.0	60.0		
18	44.5	46.5	48.5	50.5	52.4	54.4	56.4	58.4	60.3		
19	44.9	46.8	48.8	50.8	52.7	54.7	56.7	58.7	60.6		
20	45.1	47.1	49.1	51.0	53.0	55.0	56.9	58.9	60.9		
21	45.3	47.3	49.2	51.2	53.2	55.1	57.1	59.1	61.0		
Mature Bulls											
24	46.4	48.3	50.3	52.3	53.9	56.0	58.0	60.0	62.0	64.0	66.0
30	47.3	49.3	51.3	53.2	54.9	57.0	59.0	61.0	63.0	65.0	67.0
36	48.0	50.0	51.9	53.8	55.5	57.5	59.5	61.5	63.5	65.5	67.4
≥ 48	48.5	50.4	52.3	54.1	55.9	58.0	60.0	62.0	63.9	65.8	67.7

Source: Beef Improvement Federation, 2016

Table 2. Hip Heights (inches) and Frame Score for 5 – 21 Month-old Heifers and Mature Cows

Age (months)	Frame Score										
	1	2	3	4	5	6	7	8	9	10	11
5	33.1	35.1	37.2	39.3	41.3	43.4	45.5	47.5	49.6		
6	34.1	36.2	38.2	40.3	42.3	44.4	46.5	48.5	50.6		
7	35.1	37.1	39.2	41.2	43.3	45.3	47.4	49.4	51.5		
8	36.0	38.0	40.1	42.1	44.1	46.2	48.2	50.2	52.3		
9	36.8	38.9	40.9	42.9	44.9	47.0	49.0	51.0	53.0		
10	37.6	39.6	41.6	43.7	45.7	47.7	49.7	51.7	53.8		
11	38.3	40.3	42.3	44.3	46.4	48.4	50.4	52.4	54.4		
12	39.0	41.0	43.0	45.0	47.0	49.0	51.0	53.0	55.0		
13	39.6	41.6	43.6	45.5	47.5	49.5	51.5	53.5	55.5		
14	40.1	42.1	44.1	46.1	48.0	50.0	52.0	54.0	56.0		
15	40.6	42.6	44.5	46.5	48.5	50.5	52.4	54.4	56.4		
16	41.0	43.0	44.9	46.9	48.9	50.8	52.8	54.8	56.7		
17	41.4	43.3	45.3	47.2	49.2	51.1	53.1	55.1	57.0		
18	41.7	43.6	45.6	47.5	49.5	51.4	53.4	55.3	57.3		
19	41.9	43.9	45.8	47.7	49.7	51.6	53.6	55.5	57.4		
20	42.1	44.1	46.0	47.9	49.8	51.8	53.7	55.6	57.6		
21	42.3	44.2	46.1	48.0	50.0	51.9	53.8	55.7	57.7		
Mature Cows											
24	43.1	45.0	46.9	48.8	50.7	52.5	54.5	56.4	58.2	60.1	62.0
30	43.8	45.8	47.5	49.4	51.3	53.1	55.1	57.0	58.9	60.8	62.5
36	44.2	46.1	48.0	49.8	51.8	53.6	55.5	57.2	59.2	61.0	62.8
≥ 48	44.6	46.5	48.2	50.0	52.0	53.9	55.8	57.5	59.4	61.2	63.0

Source: Beef Improvement Federation, 2016

HOW TO USE FRAME SCORES

Matching cows to the environment. Larger framed cows take more feed to meet their nutrient requirements. The key question is: Does a cow's frame size affect her ability to meet her nutrient requirements from grazing? In other words, does she match her environment? Range and pasture grazing resources vary tremendously in amount of forage and level of nutrition in the forage. Thus, cow size needs to be matched to local grazeable forage resources. Allowing mature cow size to increase without managing it

can lead to cows that will be challenged to be productive under limited forage resources in semi-arid and arid environments. They cannot graze enough forage under scarce conditions to meet their nutrient requirements. If cows are too big, they will struggle to remain reproductively sound unless additional, harvested feed resources are provided. On the other hand, small-framed cows will underutilize resources in a more productive environment. Smaller framed cows simply cannot produce enough pounds of weaned calves to efficiently utilized abundant forage resources in wetter environments.

The mismatch of cow frame size to environment influences two important production variables: reproductive performance and calf weaning weight. Because reproduction is the first physiological function that is sacrificed when nutrient requirements are not met, the limited forage situation will cause delayed return to cyclicity and reduced fertility in large-framed cows. Additionally, limited nutrition will also reduce nutrients partitioned to milk production, leading to calves being unable to reach their potential weaning weight. The ultimate result is that large-framed cows will not produce to their genetic ability because they are unable to consume enough forage to meet their nutrient requirement in a limited-resource environment.

Matching sires to dams. Producers may notice that frame score of the cow herd or calf crop tends to change through management decisions such as genetic selection to produce larger feeder calves or moderating cow size to fit the environment. Changing frame score in the cowherd or crop calf can be achieved through proper sire selection and selective culling within the cow herd. In addition to the genetic traits being considered during bull selection, frame score should be one additional factor to consider. Frame score should be considered whether mating is occurring through natural service or artificial insemination.

Reducing frame score can be achieved through selecting sires with smaller frame score and mating with the given cow herd. This type of mating should assist with managing dystocia. Taking hip height measurements and calculating frame score when selecting replacement heifers can move the cowherd to the desired frame scores.

Increasing frame score is achieved through the same process by using sires with larger frame scores. Caution should be used when increasing frame score because dystocia could be a potential result. Increasing frame score should be a gradual process. Again replacement heifers can be selected based desired frame score as well as a producer's "normal" selection criteria.

Matching feeding management with frame score. Selection of the post-weaning feeding program needs to match the feeder animals' potential for growth and mature size for ultimate success. Table 3 shows the relationship of frame score to projected slaughter weight. Please note the research was published in 1988. In present-day cattle with increased growth and muscling, it could be predicted that carcass weights have likely increased for the various frame scores. While the numbers may have increased slightly, the pattern would be similar. Based on Table 3, mature cow weight was similar to steer slaughter weight, and that pattern would likely be similar today.

Table 3. Relationship of frame size to projected mature cow weight and slaughter weight at Choice Quality Grade

BIF Numerical Frame Score	USDA Feeder Calf Frame Score	Mature Cow Weight	Steer Slaughter Weight	Heifer Slaughter Weight
2	Small	955	850	700
3		1030	950	800
4	Medium	1100	1050	900
5		1175	1150	1000
6	Large	1250	1250	1100
7		1320	1350	1200
8		1395	1450	1300
9		1470	1550	1400

Source: Adapted from Fox et al. (1988)

The challenge of small versus large framed cows is often debated, hence calves can be found with a variety of frame scores. Recent research in North Dakota (Sentürklü et al., 2017) evaluated small (averaged 3.77) and large (averaged 5.52) framed calves through an integrated production system (grazed native range, field pea-barley intercrop, and unharvested corn for 82 days before transfer to feedlot) as well as steers moved directly into the feedlot (218 d). Large-framed steers had heavier carcasses compared to small-framed steers and steers that grazed for 211 days had heavier carcasses compared to the steers that went directly to the feedlot. Small-framed steers produced smaller ribeye area (sq. in) compared to large framed animals; the magnitude of these difference were larger for the steers that were placed directly into the feedlot. The percentage of steers grading Choice was not different between frame scores. They did not report yield grade. At SDSU, we have seen similar results with smaller framed cattle on an accelerated feeding program for calf-feds. Small-framed steers are lighter weight at the finished target (0.4 inch backfat), produce more yield grades 4 and 5, and carcass value is less. When the small-framed calves were backgrounded prior to an accelerated feeding program, finished weight was heavier and less yield grades 4 and 5 were produced.

CONCLUSIONS

Frame scoring is a tool that can be used to make important management decisions. From a genetics standpoint, it can be used to evaluate how genetic selection has influenced the mature skeletal size of cows in a herd. Additionally, it can be used to measure progress in genetic selection to change the average frame score of a cow herd. From a production environment standpoint, it can be used to plan and manage the required resources to support a herd of a given frame size. For example, feed resources can be procured and managed to meet the increasing nutrient requirements associated with larger cows. Frame scoring can also be used to manage the growing and finishing phases of feeder cattle. Calves with smaller frame scores can be grown in backgrounding or stocker programs to

assure adequate skeletal growth before finishing to achieve targeted carcass weights with desirable USDA yield and quality grades. Alternatively, larger framed calves can be finished as calf-feds to ensure that carcass weights do not become excessive before reaching targeted USDA quality grades.

REFERENCES

Beef Improvement Federation 2016. Guidelines for Uniform Beef Improvement Programs. pp. 28-31.

Fox, D. G., C. J. Sniffen and J. D. O'Connor. 1988. Adjusting nutrient requirements of beef cattle for animal and environmental variations. J. Anim. Sci. 66:1475-1495.

Sentürklü, S., D. G. Landlbom, R. J. Maddock, T. Petry, and S. I. Paisley. 2017. Effect of retained ownership and vertical integration with an integrated cropping system among yearling steers of differing frame score on feedlot performance, carcass measurements, and systems economics following delayed feedlot entry. Proc., Western Section, American Society of Animal Science 68:203-207.

FRAME SCORE WORKSHEET

Males (5 to 21 months of age):

$$\text{Frame Score} = 0.4878\,(\text{Height}) - 0.0289\,(\text{Days of Age}) + 0.00001947\,(\text{Day of Age})^2 + 0.0000334\,(\text{Height})(\text{Days of Age}) - 11.548$$

Example: Bull calf is 45.5 inches tall at 210 days of age

Constants	Variables	Example Results	Your Results
0.4878 x height	45.5	22.19	
-0.0289 x age	210	-6.07	
0.00001947 x age^2	$210^2 = 44{,}100$	+0.86	
0.0000334 x height x age	45.5 x 210 = 9555	+0.32	
-11.548		-11.548	
SUM		**5.76**	

This example bull has a frame score of 5.76.

Females (5 to 21 months of age):

Frame Score = 0.4723 (Height) – 0.0239 (Days of Age) + 0.0000146 (Day of Age)^2 + 0.0000759 (Height)(Days of Age) - 11.7086

Example = Heifer calf is 42.3 inches tall at 185 days of age

Constants	**Variables**	**Example Results**	**Your Results**
0.4723 x height	42.3	19.98	
-0.0239 x age	185	-4.42	
0.0000146 x age^2	185^2 = 34,225	+0.50	
0.0000759 x height x age	42.3 x 185 = 7825.5	+0.59	
-11.7086		-11.7086	
SUM		**4.94**	

This example heifer has a frame score of 4.94.