

Matching Breeding Programs With Industry Targets: Use of Frame Scores and Mature Weight in Beef Cattle Selection

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For years cow-calf producers have been told by industry "experts" to produce a product that will "fit the box" and satisfy consumer demands. This directive has been given without providing a detailed description of what was actually desired. Cow-calf producers in turn asked for specific targets from the packers and retailers. Over the past five years a fairly specific set of targets has been developed and put in front of the beef industry. Very little has been offered up to assist producers in making decisions on selecting breeding stock to allow them to consistently hit the targets and still maintain production efficiency.

As the beef industry progresses and strives to achieve some degree of uniformity in slaughter cattle, variation in skeletal size will need to be monitored and controlled. Many environmental factors can and do have an impact on growth rate and resulting mature size, or physiological maturity. However, the industry has identified what the end product should look like. Breeding programs need to be designed to pursue these targets. By taking the packer targets, which are based on consumer demand for product, one can back calculate to determine the ideal slaughter weight for fed cattle. Then by taking known relationships between mature weights of cows and bulls and the slaughter weight of offspring the "ideal" cow and bull weight, to produce that animal, can be determined. Next the producer has to make the determination of whether that breeding program will match up with the environment where it will be carried out.

Environmental constraints and resulting forage availability will create regional variation in the most appropriate size and genetic makeup of a breeding herd. Tremendous attention is given to mature cow size when adapting cows to any given environment. Very often, mature size is not as critical as milk producing ability of the female. Many of the larger continental breeds also have the genetic ability to produce above average quantities of milk. This milking ability, along with larger frame size, is the main reason that lower reproductive performance is observed in these types of cattle when asked to produce under more arid conditions.

This points out the need to select cattle based on multiple traits rather than single traits such as frame, muscling, weight, milk or carcass merit. Balanced trait selection is desired and achievable. One of the most confusing production tools available for use in selecting replacement females and herd sires is frame score. In addition, selection for a given frame score is not a pure science. Some associations between frame size and mature weight of cows has developed by evaluating research data generated over the past few years. There is less research information available on the mature weight of bulls of a given frame score. Throughout this paper the weights expressed for a given frame score is assumed to be from cattle with average

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muscling and in average flesh. Average flesh is being described as a body condition score (BCS) of five. If information is needed on BCS scores, refer to TAEX Extension Bulletin B-1526 Body Condition, Nutrition and Reproduction of Beef Cows.

What has the beef industry identified as the most desirable slaughter animal is detailed in Table 1. Carcass weights range from 650 to 850, with 750-775 being the actual target. This assumes a yield grade 3A or lower which corresponds to the assumption of .5 inch of backfat with average muscling (1.7-1.8 square inches of ribeye per 100 pounds of carcass).

Table 1. Industry targets for carcass Characteristics.

Characteristics	Target	Acceptable Range	Discounts Applied ¹	
			Min	Max
Slaughter Weight	1225	1025- 1350	900	1425
Carcass Weight (lbs.)	775	650 - 850	600	900
Ribeye Area (sq. in)	14	11 - 15	10 - 16 ²	
Ribeye Area/ cwt. Carcass wt.	1.8	1.7 - 1.9	1.5 - 2.0 ²	
Yield Grade (1-5)	2	1 -3A	3B - 4-5 ²	
Backfat Thickness (in)	.4	.1 - .6	Relates to yield grade ²	
Quality Grade	Choice	Prime - Select	Standard	
Marbling	Small	Slight(50)-Abundant(100)	Traces (100)	
Maturity	A	A - B	B	

¹ Actual acceptable amount and discount applied varies with individual processes and current conditions.

² These factors are reflected in the yield grade. Any discounts would be reflected in price discounts for yield grade 3B or higher cattle and price premiums for yield grade 1 or 2 cattle.

Use of frame score and/or mature cow and bull weight, in selection of breeding stock, is not a common practice among commercial cattlemen. Most often it is because frame scores are not available from the seedstock or replacement female producer. A poor understanding of the relationship of frame score to projected mature weights in the cow herd or the projected slaughter weights of their offspring also limits use of this information. Commercial cattlemen know what cows weights are but most do not know how that relates to the slaughter weight of offspring.

Table 2 shows the relationship of frame size to expected mature weight of bulls and cows and resulting carcass weight of offspring of the same frame size. Many factors, such as calf-fed versus feeding as a yearling, can alter this projected end weight.

In referring to the Table 2, it appears that given the specifications and estimates of weight that animals with a frame score of 5 or 6 will produce **both** steers and heifers that fall within the target for carcass weight. The cow size to produce these calves is 1200-1300 pounds, when

mated to bulls of equivalent frame and weight. Smaller framed cows mated to larger framed bulls, or vice-versa, would also produce acceptable harvest weights.

Acceptable steer weight can be achieved with lighter cows and equivalent size sires. However, non-replacement heifers will not achieve acceptable weights without maintaining heifers to older ages. Recent changes in evaluating carcass maturity may place these heifers in jeopardy of being classified as "B" maturity. If classified as B maturity these cattle will only qualify for a quality grade of Standard and take a significant discount at the packing plant.

Most industry "experts" have recommended or suggested that the ideal beef cow would be a maximum of 1200, with the ideal weight being around 1100. If replacement females are kept and uniformity is a goal, a herd of frame score 5.5 cows mated, weighing 1250 pounds, to frame score 5.5 bulls, weighing 2000 pounds, would perpetuate itself and produce steers and heifers considered an ideal carcass animal, from a weight standpoint.

If environmental constraints demand smaller mature cow weights, then frame score 3 and 4 (1000-1100 lbs.) cows can be used. The resulting steer calves will have acceptable weights but the heifers will be below the target carcass weight range of 650 to 850. When environmental adaptability is considered against producing the "ideal" slaughter heifer, adaptability should be sought.

Table 2. Relationship of frame score to mature and slaughter weights in beef cattle.

Frame Score	USDA Size Classification	Mature Weights ¹		Choice Slaughter Weight ⁴		Carcass Weight ⁵	
		Cow ²	Bulls ³	Steers	Heifers	Steers	Heifers
1	Small	850	1400	850	700	540	445
2	Small	955	1530	955	810	606	514
3	Small-Medium	1000	1600	1000	875	635	556
4	Medium	1110	1775	1110	945	705	600
5	Medium-Large	1200	1920	1200	1020	762	648
6	Large	1295	2070	1295	1100	822	699
7	Large	1400	2240	1400	1190	889	756
8	Large	1515	2425	1515	1285	962	816

¹These are estimates of average weights for each given frame score. Significant variations can result due to differences in body composition, primarily muscling.

²Cow weight estimated at body condition score of 5.

³Bulls are assumed to be 160% of cows' weight.

⁴Choice slaughter weight is determined by .5 inches of backfat. Heifers weigh on the average 175 pounds less at choice weight.

⁵Carcass weight estimated using a dressing percent of 63.5. Normal dressing percent will range from 63% to 64.5% at .5 inches.

One way to manage using smaller framed cows is to push the upper limit in bull selection by mating a frame 3 cow to a frame 6 or 7 bull, 1000 pound cows to 2000-2300 pound bulls. Offspring produced should fall into the acceptable carcass weight range, however, variation will exist. When using this approach, caution must be used when selecting herd sires. Careful attention must be used to select bulls with low to moderate birth weights to prevent dystocia in the mature cow herd. Retention of heifers from this mating program would lead to increased cow weights over time.

To determine where the current herd frame score is, it is not necessary to measure the existing herd. Remember that a balance between frame and muscling is important. Cattle with excessive muscle will weigh more at a lower frame score but ribeye area may exceed the target. Monitor cull cow weights and BCS at time of marketing. If cull cow weights average 1200 pounds at a BCS of 5, the average cow frame score will be around a 5. If cow weights have been increasing during recent years due to bull selection and/or female replacement practices, average frame score of the remaining cows may be closer to a 6 due to the younger females being larger than the older cull cows. If possible, weigh and/or measure herd sires to determine frame size or mature weight.

By taking cow and sire frame scores or weights, an estimate of offspring slaughter weights can be derived. This will help producers estimate the acceptability of their cattle from a weight standpoint. Muscling and ability to produce marbling will still have to be measured in the carcass or estimated through use of technologies such as ultrasound.

Table 3. Estimated Weight for a 1200 pound cow at varying body condition.

BCS	Expected Weight	Ratio of Weight to BCS 5	Percentage of weight at BCS 5 to change 1 BCS
1	888	.740	5.8
2	957	.798	6.2
3	1032	.860	6.7
4	1112	.927	7.3
5	1200	1.000	8.0
6	1296	1.080	8.7
7	1400	1.167	9.1
8	1510	1.258	10.2
9	1632	1.360	

Not all cows, in fact most, will not be marketed in a BCS 5. In order to get an accurate comparison of actual cow weight cull weights would need to be adjusted. To adjust cows with different BCS at marketing to BCS 5 remember that for every change in BCS, cow weight varies 6 - 10 %. Table 3 indicates expected weights of a 1200 pound cow with varying levels of fatness . The ratio of weight to BCS 5 and percent of weight at BCS 5 to change one body condition score remains the same regardless of the weight of the cow at BCS 5.

For an example on how to use these values, consider the following; A cull cow was sold in a BCS of 7. Actual sale weight was 1300 pounds. What would she weigh in a BCS of 5? This cow would weigh 16.7 % (8.0 %+ 8.7 %) less as a BCS of 5 than she did as a BCS of 7. To determine the cows weight at BCS 5 take actual sale weight of 1300 and divide it by the "ratio of weight to BCS 5" ($1300 / 1.167 = 1114$ pounds). The weight of this 1300 pound cow in a BCS 5 would be around 1115 pounds.

It is important to make these adjustments to get an accurate feel of the potential slaughter weights for the offspring out of these cows. Conversely, it is just as important to adjust the weight of thin cows to determine expected weight at BCS 5. For an example of this conversion consider a cow in BCS 4 weighing 1000 pounds. Her expected weight at BCS 5 would be ($1000 / .927$) or 1078 pounds.

When possible collect information on actual feedlot performance and harvest weight of offspring from specific breeding and management programs. Use this information to develop appropriate weight relationships for each breeding program. There are several ways to collect this information ranging from retained ownership to participation in programs such as Ranch to Rail or other breed sponsored feed-out events. This information can also be captured by working with the people that purchase calf-crops and feed them through to processing at the packing plant.

This is not an option for the smaller producer that markets calves through an auction facility. One of the feedout programs may be the only way for these producers to assimilate the close out and carcass information on calf crops. Since over 50 percent of the cattle produced in this country come from herds with less than 100 head of cows these producers need to make the effort to see how there cattle fit within the specifications outlined earlier.

On a realistic note, the industry will have to accept the fact that most of these smaller producers are not concerned about how their few calves are performing against industry changes. The only way change can be forced on this segment of the industry is through economic pressure. When discounts for these cattle are high enough some producers will change. Other producers in the industry also need to do a better job of educating fellow ranchers on the targets and how to economically achieve them. The tools and information are available to reach the targets. Teaching and convincing someone to use them is not always and easy task. It will continue to take a concerted effort by the industry to get it accomplished. As stated earlier the use of frame size and weight are tools readily available to all producers. Knowing when and how to use them continues to be the challenge.

One of the best uses of frame scores will be in the selection of young replacement stock. When actual age is known, frame score will be as accurate, if not more so, at predicting mature weight than actual weaning and/or yearling weight. Nutritional level can adversely affect the weights acquired at time of weaning and yearling measurements, making them unreliable at predicting mature size.

There is some variation between breeds as to rate of growth and age at which mature height and weight are achieved. These are the exception rather than the rule. Table 4 can be used to estimate frame score of cattle from five to twenty-four months of age across all breeds. Some breed associations have developed their own frame score tables which vary slightly from the Beef Improvement Federation (BIF) guidelines. Table 4 represents the BIF approved measurements for determining frame score.

Before making any changes in a breeding program, a baseline of cow and bull weights needs to be achieved. If possible, correlate that to slaughter weights of steer and heifers produced from those parents. If changes need to be made, the quickest way to change is through changes in sires. If large differences exist in cow size, it will be beneficial to cull cows that are too small or too large to produce desirable replacements or acceptable feeder cattle.

What constitutes too large or small? It would be acceptable to have cows with average muscling ranging in frame score from 3 to 7 as far as producing acceptable size feeder cattle from sires of a given frame score. This says nothing about the environmental adaptability or production efficiency of those extremes. In some areas of Texas, a frame score 3 cow may be too small and, conversely, there are areas where frame 7 is excessive in size.

By mating a herd of cows ranging from frame 3 to frame 7, weighing 1000 to 1400 pounds, to a frame score 5 to 6 bull, offspring will be produced that are close to industry targets for weight and more uniform in frame size than the dams that raised them. Uniformity can be achieved within two to three calf crops if consistency in frame size of sires used is followed. More rapid progress can be made if the extremes are culled out of the cow herd.

Table 4. Cattle Frame Scores Based on Hip Height in Inches^{1/}

FEMALES													
Age in Months	Frame Score ^{2/}					Age in Months	Frame Score ^{3/}						
	3.0	4.0	5.0	6.0	7.0		8.0	3.0	4.0	5.0	6.0	7.0	8.0
5	37.5	39.5	41.6	43.6	45.6	47.7	37.2	39.3	41.3	43.4	45.5	47.5	
6	38.8	40.8	42.9	44.9	46.9	48.9	38.2	40.3	42.3	44.4	46.5	48.5	
7	40.0	42.1	44.1	46.1	48.1	50.1	39.2	41.2	43.3	45.3	47.4	49.4	
8	41.2	43.2	45.2	47.2	49.3	51.3	40.1	42.1	44.1	46.2	48.2	50.2	
9	42.3	44.3	46.3	48.3	50.3	52.3	40.9	42.9	44.9	47.0	49.0	51.0	
10	43.3	45.3	47.3	49.3	51.3	53.3	41.6	43.7	45.7	47.7	49.7	51.7	
11	44.2	46.2	48.2	50.2	52.2	54.2	42.3	44.3	46.4	48.4	50.4	52.4	
12	45.0	47.0	49.0	51.0	53.0	55.0	43.0	45.0	47.0	49.0	51.0	53.0	
13	45.8	47.8	49.8	51.8	53.8	55.8	43.6	45.5	47.5	49.5	51.5	53.5	
14	46.5	48.5	50.4	52.4	54.4	56.4	44.1	46.1	48.0	50.0	52.0	54.0	
15	47.1	49.1	51.1	53.0	55.0	57.0	44.5	46.5	48.5	50.5	52.4	54.4	
16	47.6	49.6	51.6	53.6	55.6	57.5	44.9	46.9	48.9	50.8	52.8	54.8	
17	48.1	50.1	52.0	54.0	56.0	58.0	45.3	47.2	49.2	51.1	53.1	55.1	
18	48.5	50.5	52.4	54.4	56.4	58.4	45.6	47.5	49.5	51.4	53.4	55.3	
19	48.8	50.8	52.7	54.7	56.7	58.7	45.8	47.7	49.7	51.6	53.6	55.5	
20	49.1	51.0	53.0	55.0	56.9	58.9	46.0	47.9	49.8	51.8	53.7	55.6	
21	49.2	51.2	53.2	55.1	57.1	59.1	46.1	48.0	50.0	51.9	53.8	55.7	
Mature	52.3	54.1	55.9	58.0	60.0	62.0	48.2	50.0	52.0	53.9	55.8	57.5	
Frame Score (5-21 months) = 0.4878 (Ht) - 0.0289 (Days of Age) + 0.00001947 (Days of Age) ² + 0.0000334 (Ht) (Days of Age) - 11.548							Frame Score (5-21 months) = 0.4723 (Ht) - 0.0239 (Days of Age) + 0.0000146 (Days of Age) ² + 0.0000759 (Ht) (Days of Age) - 11.7086						
Steer Slaughter	1025	1110	1200	1295	1395	1500	Heifer Slaughter	870	945	1020	1105	1185	1275
Mature Bull Weight ^{6/}	1615	1750	1890	2040	2195	2360	Mature cow weight ^{7/}	1025	1110	1200	1295	1395	1500

^{1/} Approved by the Beef Improvement Federation.

^{2/} Steers continue growth longer than bulls, being about one-half to one inch taller at 18 to 21 months.

^{3/} USDA MEDIUM FRAME SIZE is approximately frame score 3.0 to 5.0. USDA LARGE FRAME SIZE is approximately frame score 5.0 to 7.0.

^{4/} If calved first at 2 years old. Add 1 inch if calved first at 3 years.

^{5/} At 0.5 inch fat cover.

^{6/} At 12 - months, bulls weigh 50-60% of this mature weight, under most development programs.

^{7/} Moderate body fatness, cow Body Condition Score 5 (where 1 = extremely thin and 9 = obese, cow weight varies 7% to 8% per condition score and up to 10% for extremes in muscling). For breeding at 14-15 months heifers should weigh 60-65% of this mature weight.