

BEEF SELECTION TECHNIQUES FOR THE NEW TRENDS IN THIS MODERN DAY BEEF INDUSTRY

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Today's business-minded progressive cattlemen concern themselves with the application of research-proven, efficient and profitable beef production and management practices. Successful beef producers realize that real success is measured in the profit and loss statement of their beef herd, which can easily be analyzed by the following:

Economic Effects for Genetic Trait Selection and Management Practice Application

$$\begin{array}{ccccccc} \text{Profit} & & & & & & \text{Annual} \\ \text{or} & = & \text{Weaned} & & \text{Pounds at} & & \text{Production} \\ \text{Loss} & & \text{Calf Crop} & \times & \text{Weaning} & \times & \text{Costs} \\ & & & & & & \text{Minus} \\ & & & & & & \text{Price per} \\ & & & & & & \text{pound} \end{array}$$

Profit or loss is determined by the weaned percent of calf crop multiplied by the average weaning weight and dollar market value minus the annual costs of production and marketing. Constant reference to this simplified formula standard allows for genetic trait selection and management practice decisions to be evaluated against each of the four economic indicators and the effects of each component or overall contribution to the “profit or loss”. Beef cattle traits or characteristics normally include body size, milking potential, age at puberty, adaptability, conditioning, muscling, cutability, and marbling.

BULL SELECTION

Successful producers realize benefits from the finest nutrition and management programs are not maximized unless their cattle have the genetic capability for rapid growth and, efficient reproductive performance. Calves indicating those characteristics demand top dollar at the marketplace. **Bull selection is the foundation for building a profitable beef herd.** The producer's goal in profitable beef production is to improve the average performance and quality of the offspring through genetic improvement. Three important factors in bull selection must be considered.

1. The selection must be *accurate*.
2. The selection must be for *heritable traits*.
3. The selection must be for *traits of economic value*.

Objective measurements include individual and progeny records of performance and carcass characteristics for such traits as birth weight, weaning weights, average daily gain, feed efficiency, yearling weights, quality and yield grades and others. For these growth traits, carcass traits and maternal traits, beef breed associations have made sire selection even more accurate by using the information on a calf's relatives in addition to its individual record to estimate the *Expected Progeny Difference (EPD)* for different traits.

Subjective evaluations include visual appraisal, which is still very important in herd bull evaluation. Cattlemen can visually evaluate cattle with some accuracy for composition of gain, structural soundness, reproductive soundness, muscling quantity and correctness, temperament, balance and general eye appeal. All these criteria are economically important, but must be coupled with objective performance information to make more accurate selection decisions. New technology can replace some subjective evaluation and assist visual appraisal. For example, the use of ultrasound can determine muscling, fat measurements, and even marbling scores. New technology and research has also led to more accurate determination of body composition and breeding soundness evaluation including semen evaluation, scrotal circumference, and even libido or sex drive.

THE PROCESS OF SELECTING BULLS

The process of bull selection begins when the producer decides on the breed needed for the ranch resources. This decision should be based on environmental resources (land, feed, labor, facilities, water, weather, etc.) and marketing environment (cow herd, breeding or slaughter, market demand, and the breeding plan). The goal is to select a bull from a breed or breed combination that best combines functionality in an environment that is capable of siring calves with *several traits* that will contribute to overall herd profitability (Table 1).

Next, the producer should determine where to buy this bull. Cattlemen should only buy from reputable sources that can provide complete individual performance records, EPD, breeding soundness evaluation results, a guarantee of fertility and a guarantee that ancestors are not known carriers of genetic defects. Sources of such bulls include herds actively involved in performance evaluation programs, central bull test stations, or consignment sales. Purchases may also be made by private treaty.

After the type of bull and source has been determined, the evaluation of bulls for economical traits and their performance begins. This involves evaluating each individual for structural soundness, fertility, growth, calving ease, frame size, maternal performance, and carcass characteristics.

Table 1. Bull selection goals for some economically important traits

<u>Traits</u>	<u>Optimum</u>	<u>Target</u>
Reproduction		
Age at Puberty (mos)	12-16	14
Scrotal Circumference (cm)	30-40	35
Growth		
Birth weight (lbs)	60-90	75
Weaning weight (lbs)	425-600	560
Feedlot gain (lbs/day)	2.5-4.0	3.5
Yearling weight (lbs)	900-1200	1120
Frame Score	5-8	7
Carcass		
Carcass weight (lbs)	600-800	700
Carcass Quality Grade	Select-Choice	Choice
Carcass Yield Grade	1.5-3.5	2.5
Ribeye Area (in ² /cwt live wt)	1.2-1.5	1.4
Fat thickness (in/cwt live wt)	.02-.03	.025
Dressing Percent	60 or higher	63

Structural soundness is of great economic importance and is determined by subjective visual evaluation. This also provides an excellent opportunity to evaluate his disposition. Select those bulls that are docile because unruly progeny sometimes have reduced gains and reduced quality grades. A bull must be functionally sound and free from any structural defects that would limit physical activities such as feeding, walking, and breeding cows. Any physical impairment that would affect the bull's ability to service cows, maintain a healthy condition, or decrease longevity would ultimately reduce profits. (Figure 1)

Some examples of more common structural problems include:

- Bad feet
- Curled/twisted toes
- Pigeon toed
- Splay footed
- Long toes
- Coon footed
- Short, straight pasterns
- Weak pasterns
- Bow-legged
- Knock-kneed
- Buck-kneed
- Straight hocks
- Post-legged
- Sickie hocked
- Straight shoulders
- Weak back or loin

Structure is best evaluated from the ground up. Start by inspecting the hoofs, heels, pasterns, knees, hocks, shoulders, hooks, pins, rump, and back. Pay close attention to these areas as the animal moves, and watch for freedom of movement and that each hoof strikes the ground evenly.

Breeders sometimes are over critical of observed structural problems that may be tolerated but detract from the aesthetic beauty, symmetry, or conformation of a bull. These may not interfere with function but is a valid criticism if these lessen "eye appeal" and ultimately the value of an animal. Remember that structural characteristics are heritable and both the good and bad will be transmitted to the offspring including "eye appeal."

Fertility was once evaluated simply by visual appraisal alone and some conclusions about sex character and soundness in relation to fertility could be determined. Producers should visually check to see if the bull has two testicles and that they are similar in size and that the testicles have a greasy, oily look instead of a scaly, dry appearance. Next, check the sheath on the bull, especially Brahman and Brahman derivative cattle for long, pendulous sheaths that hang close to the ground and select for tighter less pendulous sheaths. (Figure 3)

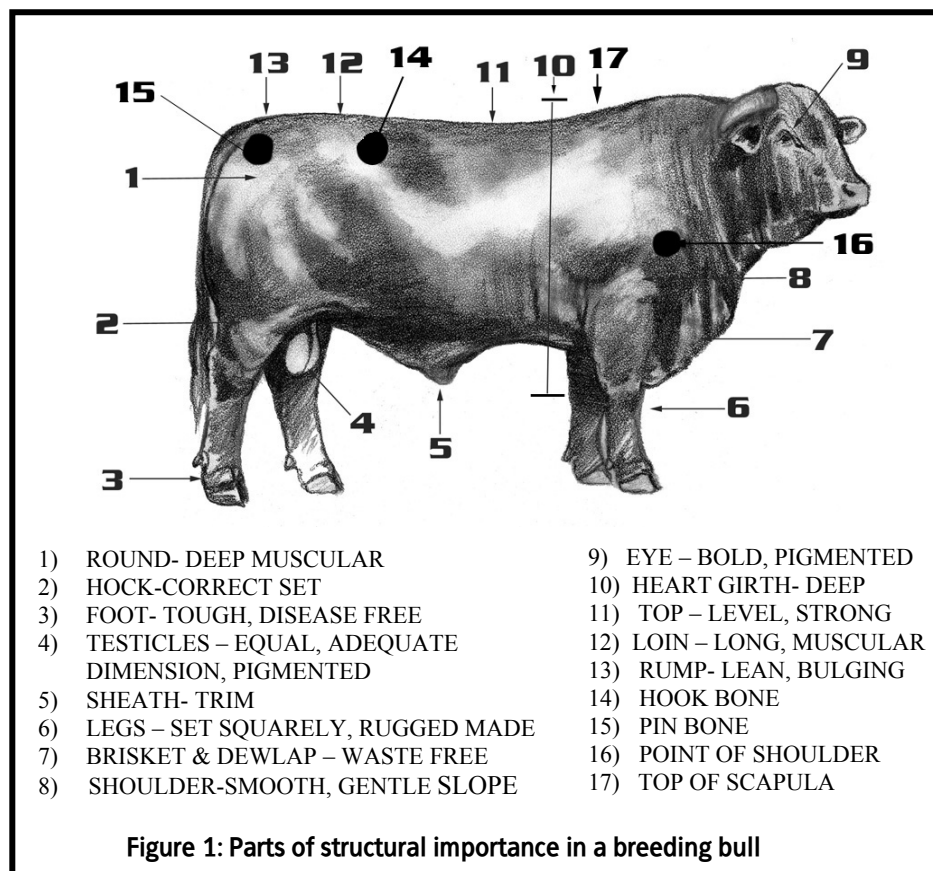


Figure 2. Comparison of non-fertile (left) vs. fertile (right) bull. Bonsma, 1966.

Figures 2, 4, and 5 are figures that were provided by Professor Jan C. Bonsma and printed in the Santa Gertrudis Breeders International Recorded Herds, Volume 3 (1966). Dr Bonsma effectively illustrated fertility indicators related to hormone differences and trained producers to visually evaluate reproductive characteristics related to subsequent reproductive performance.

The breeding soundness evaluation (BSE) is a more objective and accurate approach and has helped take the guesswork out of a bull’s fertility status. The BSE includes semen evaluation for motility and morphology, scrotal circumference measurement, and a physical examination of the reproductive tract. Scrotal circumference for one-year-old bulls should be a minimum of 30 centimeters (approximately 12 inches) and 34-cm minimum for 2-year-old bulls. Sex drive or libido may be scored objectively like many other traits; however, the producer will be best served if he makes that determination after observing the bull at work in his own herd (Table 2).

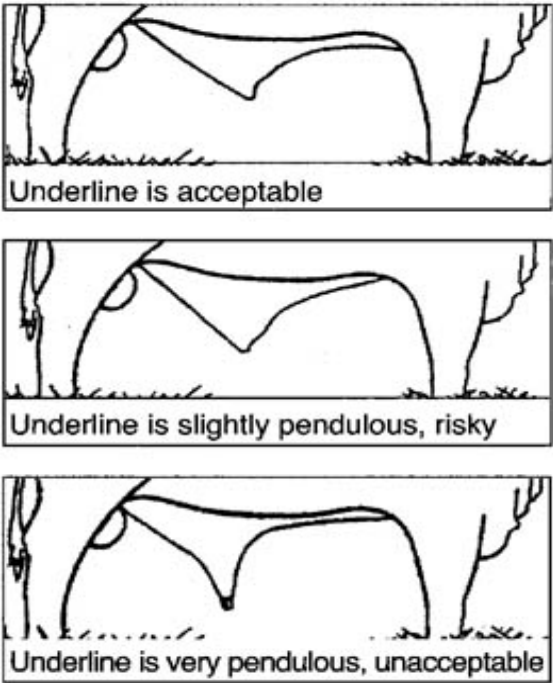


Figure 3. Sheath differences
(Courtesy L.R. Sprott)

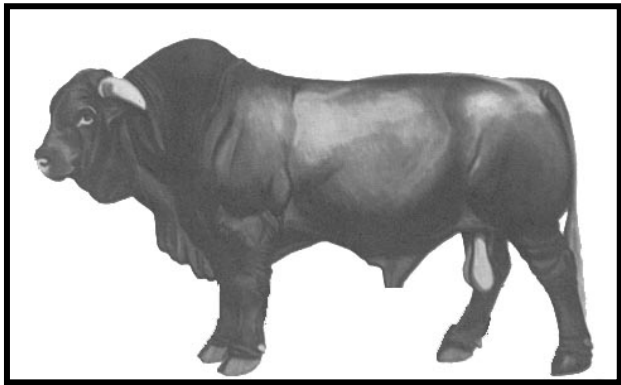


Figure 4. Example of bull displaying good fertility indicators. Bonsma, 1966.

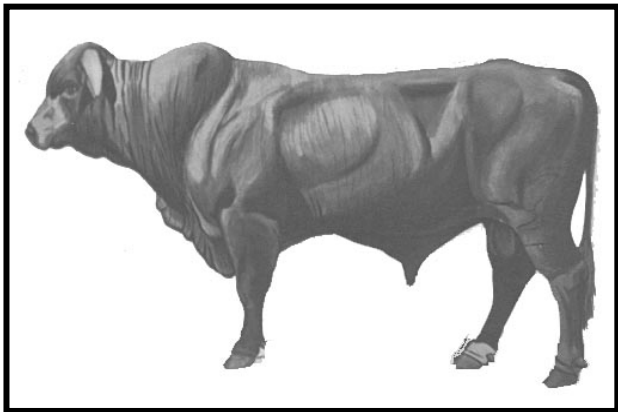


Figure 5. Example of bull displaying poor fertility indicators. Bonsma, 1966.

Bull Breeding Soundness Evaluation

SCROTAL CIRCUMFERENCE

Bull's Age (Month)	Minimal Scrotal Circumference
Under 15	30 cm
15-18	31 cm
18-21	32 cm
21-24	33 cm
Over 24	34 cm

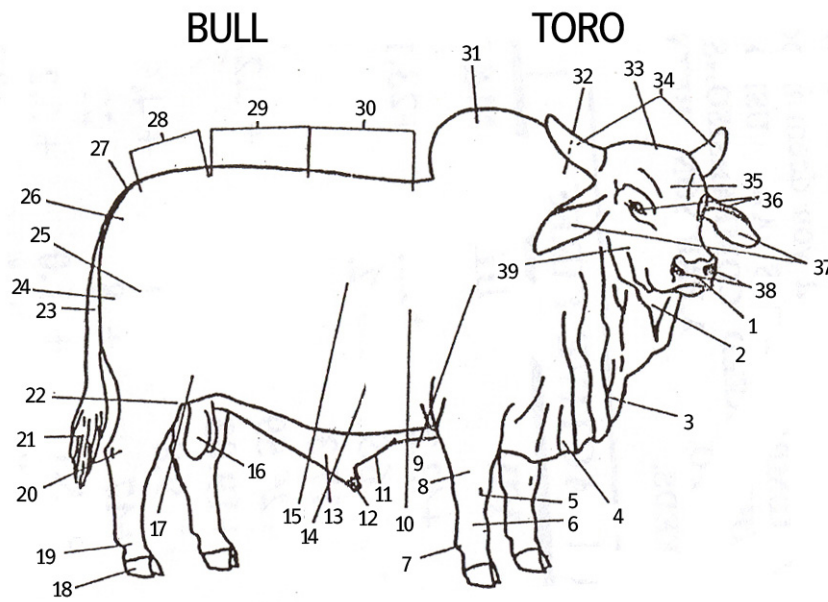
MOTILITY

Gross Activity	Individual Activity	Rating
Rapid Swirling	Above 70%	Very Good
Slower swirling	50-69%	Good
Generalized oscillation	30-49%	Fair
Sporadic oscillation	Under 30%	Poor

MORPHOLOGY

Minimum is 70 percent normal spermatozoa

Source: Society of Theriogenology

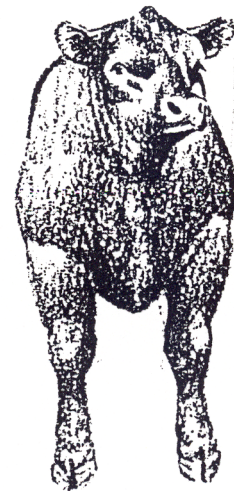
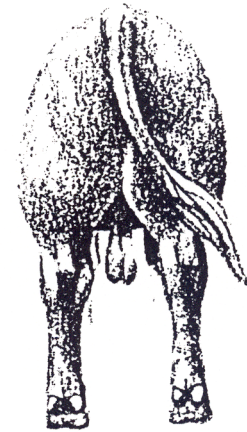
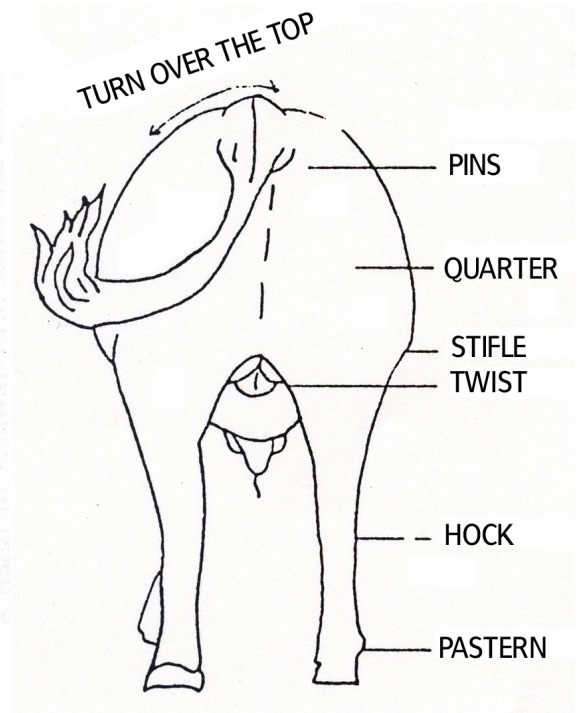


Bull

1. muzzle
2. throat
3. dewlap
4. brisket
5. knee
6. shank, cannon
7. dewclaw
8. forearm
9. shoulder
10. chest girth
11. navel
12. penis
13. sheath, prepuce
14. belly
15. ribs
16. scrotum & testes
17. flank
18. foot, hoof
19. pastern
20. hock
21. tuft or switch of tail
22. stifle joint
23. tail
24. buttock
25. thigh
26. hip
27. head of tail
28. rump
29. loin
30. back
31. hump
32. neck
33. crown, poll
34. horns
35. forehead
36. eyes
37. ears
38. nostrils
39. cheek

Toro

- hocico, morro, punta de la nariz
 garganta
 papada
 punta del pecho o esternón
 rodilla
 caña, canilla, hueso de la pata
 sobreuña, accesorios
 antebrazo
 hombro, paleta
 perímetro torácico
 ombligo
 pene
 vaina, estuche, forro, prepucio
 vientre, barriga
 costillas
 escroto y testículos
 ijada, ijar, flanco
 casco, pezuñas
 cuartilla, falange
 corvejon, jarrete, corva, tarso
 mechón o borla de la cola, mota
 rótula, articulación, patella
 cola
 nalga
 muslo
 cadera
 inserción o nacimiento de la cola
 grupa
 lomo
 dorso
 giba
 pescuezo, cuello
 corona
 cuernos
 frente, testuz
 ojos
 orejas
 ollares
 carrillo



COMMON FOOT PROBLEMS



Excessive growth
(beak claw)



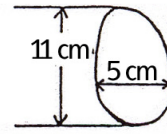
Rolled
(corkscrew) claw



Curled
(scissor) claw



Spread
(splayed) toes

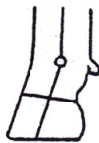


Normal claw dimensions
for 1100-1200 lb animal

I. Steep Pastern



54°
 \bar{x} normal



73°
 $\bar{x} + s$

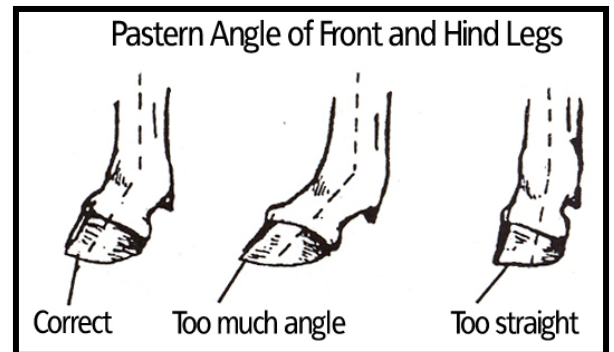


75°

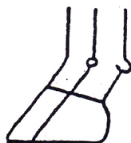


80°

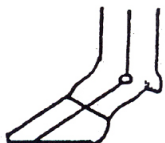
HB



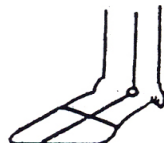
II. Weak Pastern



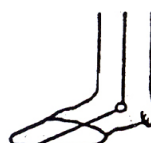
54°
 \bar{x} normal



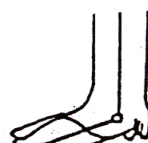
35°
 $\bar{x} + s$



30°



25°

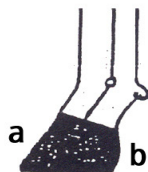


20°

HB

III. Little Heel

Fore



$$\frac{a}{b} = 1.7$$

\bar{x} normal

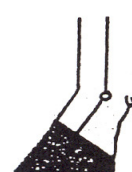


2.5

$\bar{x} + s$



3.0



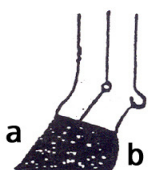
3.5

HB



4.0

Hind



$$\frac{a}{b} = 1.9$$

\bar{x} normal



2.8

$\bar{x} + s$



3.0

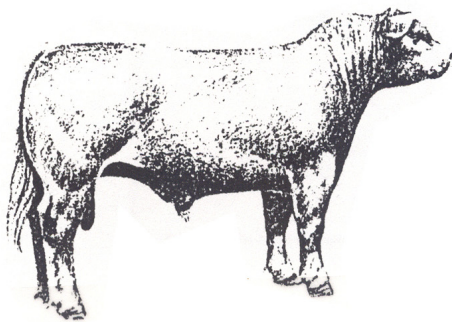


3.5

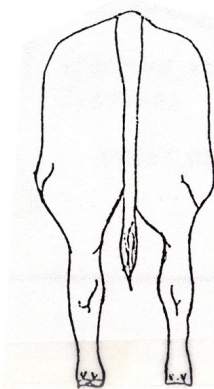
HB



4.0



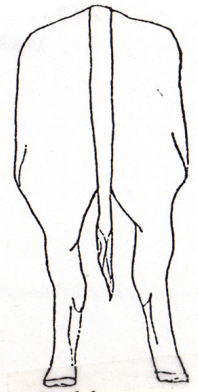
Correct Skeletal Structure



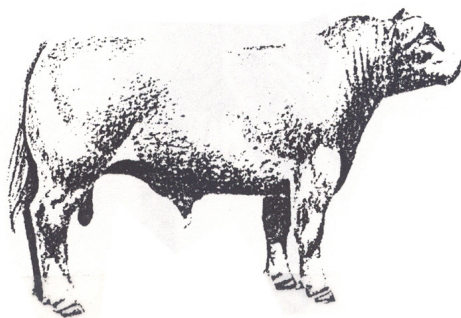
Desired Setting



Bow Legged



Cow Hocked



Sickle-hocked and Back at the Knees



Correct Setting



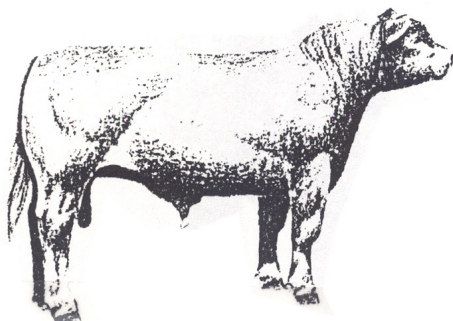
Post Legged



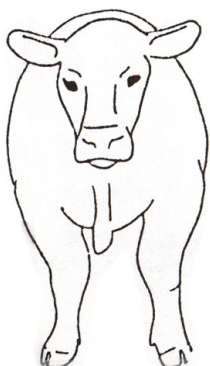
Sickle Hocked



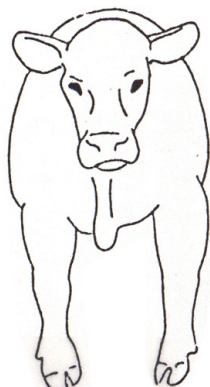
Camped Behind



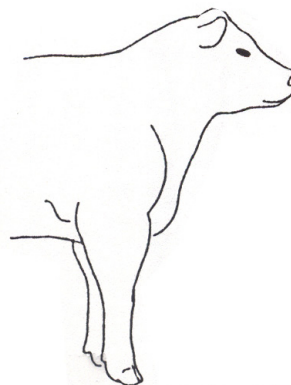
Post-legged and Buck-kneed



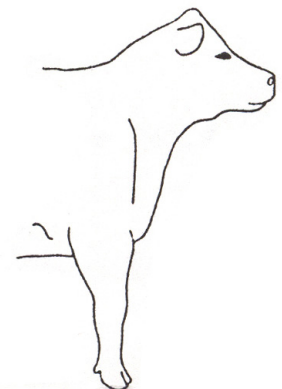
"Knock-Kneed"
"Toed Out"



"Pigeon Toed"
"Toed In"



Correct Shoulder
Set Positon



Too "Straight"
or "Steep" in the
Shoulders

Growth is measured by adjusted weaning weights, average daily gain, yearling weights and ratios and estimated breeding values for the same measurements. Generally speaking, a good performing bull's record would be approximately 560-600 pounds for weaning weight, 3.5 or better pounds per day average daily gain, and a 1120-1200 pound yearling weight. Producers need to remember that when selecting for above average growth traits, that birth weights generally increase as well. Therefore, caution must be exercised to select bulls that fit the cows' size for ease of calving. The records mentioned above may be below or higher than would be required in some cowherds and that is where individual bull data compares to his contemporaries resulting in EPD that are more accurate and beneficial than using individual data alone.

Weaning weight and yearling weight EPD are commonly referred to as growth data. Emphasis on positive growth EPD selection results in heavier calves returning more dollar value. Thus, larger WW and YW EPD have a positive economic impact on selection. Let's look at the example below:

<u>Bull</u>	<u>Weaning Weight EPD</u>	<u>Yearling Weight EPD</u>
A	+12.0	+23.0
B	+ 6.0	+10.0
C	- 8.0	- 4.0

If the production goals dictate that the offspring of these bulls would be sold at weaning, which bull is the most desirable? The answer is bull A. This is the bull with the highest WW EPD. If you compared bull A and B's WW EPD, then you would say that bull A's offspring would be (on average) 6 pounds heavier than the average offspring from bull B at weaning. What if the goal was to retain ownership of the bull's offspring and they would be fed in the feedlot and marketed as finished cattle? Then the YW EPD becomes more important. And the bull with the highest YW EPD will sire heavier offspring. Thus, bull A is still the correct answer.

Calving ease information (particularly when emphasis is placed on accelerated growth performance) may be the most important trait measurement evaluation in some herds. As already mentioned selection for higher growth traits may result in increased birth weights and calving difficulty. Birth weight has long been regarded as a major contribution factor associated with calving difficulty. Ask for records on a prospective sire indicating birth weight and calving ease as well as his relatives' data (EPD). Careful selection, well-planned breeding programs and management will help avoid calving problems. Birth weights should not be excessive in order for calving to be easy and 60-90 pound birth weights should serve a range of cow sizes from small to large. When evaluating the birthweight EPD, basically the higher the BW EPD the greater the calving difficulty is expected from the use of such sires. Consider the following example:

<u>Bull</u>	<u>Birth Weight EPD</u>
A	+5.0
B	+0.0
C	- 5.0

Imagine that a situation calls for these bulls to be mated to first calf heifers. Which bull would you most likely prefer if this was all the information you were provided? You should have chosen bull C because this bull has the lowest BW EPD. This means bull C would have calves that will average five pounds lighter than bull B and 10 pounds lighter than bull A.

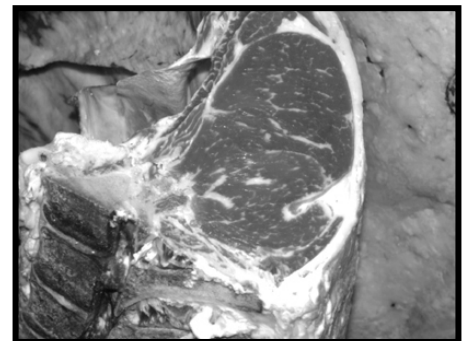
Frame size is a very effective measurement for estimating rate of maturity, mature size, and general carcass composition at a given live weight. Frame size measurement is a valuable tool when used to complement cowherd size to produce offspring that are more acceptable at the marketplace. The most generally acceptable calves at the markets are medium framed and consist of frame scores 5, 6 and 7. Bull hip heights, measured in inches at 205 days and at yearling for frame scores 6, 7, and 8 are 45 and 49; 47 and 51; and 49.75 and 55, respectively. (Table 3)

Maternal performance includes a cow's milk performance and calving characteristics. Generally speaking however, milk performance is the most often measured characteristic in this category and can best be evaluated by the EPD for milk listed in sire summaries. Without going into great detail, the basic formula for milk EPD involves measuring the additional pounds of weaning weight from daughters due to genes for milk. The following example should make this explanation clearer.

<u>Bull</u>	<u>Milking Ability EPD</u>
A	+8.0
B	-2.0

Notice that the difference in the MA EPD is 10 pounds. This does NOT mean that daughters from bull A produce 10 pounds more milk than bull B. It means that bull A's daughters would be expected to wean calves that average 10 pounds heavier because of genes associated with milk. So, which bull has a more desirable MA EPD? If higher milking ability is desired in daughters, bull A should be chosen. However, if the conditions are low forage quality, then a high EPD for milking ability could lead to problems. Heifers and cows with a high milk EPD will need a higher quality grass or supplement to reach these expected high maternal values. If the conditions dictate that forage is low quality, you should look for a lower value that is more beneficial to the situation. The amount of emphasis on this trait depends on the amount of milk production the breeder wants to put in his herd.

Carcass characteristics are receiving a great deal of attention in present-day selection programs. In the past, the best way to evaluate bulls for muscle and fat (leanness) was with progeny carcass evaluation. This still is an effective way to accurately evaluate cutability and quality grades and still is the only way to evaluate tenderness. New ultrasound technology now allows for live bull evaluation for rib eye area, fat thickness and percent fat in the ribeye equated to a marbling score. These measurements will become more important as more feeders and packers place increased emphasis in rewarding producers for cutability and quality in their slaughter



cattle. Presently visual appraisal by trained personnel is fairly accurate in predicting future cutability of feeder calves based on muscling and frame size (USDA Feeder Cattle Grades). These factors can greatly influence the price per pound received for feeder cattle. Producers should exercise caution in selecting for too much muscle or an incorrect muscle shape. It appears that 12 month old bulls weighing 1,000 pounds should have between 13-14 square inches of REA (1.3 - 1.4 sq. in. per cwt.) and 0.2 - 0.3 fat thickness.

UNDERSTANDING EPDs

As already mentioned, the use of EPD (Expected Progeny Difference) in herd bull selection is a very sophisticated tool to objectively evaluate economically important traits or differences in genetic ability of cattle. Like visual appraisal it is one more supplementary selection tool available to producers that will increase predictability in the progeny.

EPD are the most accurate means to date for estimating the true breeding value of an animal in regard to certain measurable traits. Some breeds have been determining EPD (that are based on the performance records of many herds) for a long time. Genetic ability to improve a trait has increased or decreased compared to their original base period. Some breeds have high average numbers for a trait and others have a low number for that same trait. It is helpful to know the average EPD number for each trait for each breed (Table 4)

Table 4. Example Sire Breed Average EPD

BREED	BW	WW	YW	MILK	M&G
Angus	+3.3	+25.8	+42.2	+10.2	+23.1
Beefmaster	+0.11	+ 3.48	+ 6.91	+ 2.84	
Brahman	+ 1.3	+10.0	+17.3	+ 4.4	
Brangus	+ 1.5	+15.7	+26.9	+ 0.04	+ 8.2
Charolais	+ 1.79	+12.86	+19.03	+ 1.55	
Gelbvieh	+0.3	+ 5.4	+ 9.8	+ 1.5	+ 4.5
Hereford	+3.8	+27.0	+47.0	+8.0	+22.0
Limousin	+1.5	+ 8.2	+15.1	+ 1.0	+ 5.2
Maine Anjou	0	+ 0.7	+ 1.0	- 0.1	+ 0.03
Santa Gertrudis	+0.73	+ 4.72	+ 6.45	+1.05	+ 2.88
Simmental	+0.8	+ 8.3	+13.7	+0.1	+ 4.2

One should know the breed average to determine if the animal being evaluated is above or below the breed averages for the trait being evaluated. The difference between the numbers for one animal compared to another within the breed is the expected difference between the progeny of each animal for that trait, usually expressed in pounds.

Accuracy values for each trait are important and express the estimated accuracy of repeatability for the trait. Remember, EPD are used for within breed comparisons only and not for comparison between breeds.

Table 5. Cattle Frame Scores Based on Hip Height in Inches¹ and USDA Frame Sizes

MALES ²							FEMALES						
Frame Score and USDA Frame Size ³							Frame Score and USDA Frame Size ³						
USDA	Small	Medium	Large				USDA	Small	Medium	Large			
Age in Months	3.0	4.0	5.0	6.0	7.0	8.0	Age In Months	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	5	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	6	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	7	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	8	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	9	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	10	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	11	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	12	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	13	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	14	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	15	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	16	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	17	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	18	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	19	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	20	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	21	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	Mature ⁴	48.2	50.0	52.0	53.9	55.8	57.5
Frame Score (5-21 months) = 0.4878 (Ht) - 0.0289 Formula (Days of Age) + .00001947 (Days of Age) ² + 0.0000334 (Ht) (Days of Age) - 11.548							Frame Score (5-21 months) = 0.4723 (Ht) - 0.0239 Formula (Days of Age) + 0.0000146(Days of Age) ² + 0.0000759 (Ht) (Days of Age) -11.7086						
Steer Slaughter Weight⁵	1010	1105	1200	1295	1390	1485	Heifer Slaughter Weight⁵	910	1005	1100	1195	1290	1385
Mature Bull Weight⁶	1590	1740	1890	2040	2190	2340	Mature cow weight⁷	1010	1105	1200	1295	1390	1485

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 4.0 to 5.5. USDA LARGE FRAME SIZE is approximately above frame score 5.5

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.

Marker Assisted Selection

By: Dr. Joe Paschal, Livestock Specialist

In the near future, marker assisted selection will most likely be available on a number of economically important markers allowing seedstock producers the opportunity to increase selection response over that available solely from selection utilizing EPD. Caution should be exercised against single trait selection either with MAS or EPD. EPD selection allows producers to select for improvement in several economically important traits simultaneously. In the near future, national animal ID will allow the beef industry to collect data at all marketing points and some of this data will be extremely useful in improving the number of breeds using EPD, the number of animals having EPD and in increasing the accuracy of EPD. However, MAS, like other new technology, is NOT a “silver bullet” and should only be used to enhance other performance information already being collected and utilized.