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Minimizing Calving Difficulty in Beef Cattle

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Calving difficulty (dystocia) contributes heavily to production losses in beef cow/calf herds. A Nebraska study estimated that calving difficulty results in annual losses of $25 million in that state alone. The obvious losses are due to calves or cows that die at or soon after calving. Less noticeable losses are due to delayed rebreeding, more open females, an extended calving season and increased labor costs. While occasional dystocia is almost unavoidable, cattlemen can minimize dystocia through proper management. Control of both genetics and environment (nutrition) is necessary to minimize dystocia.

As noted in **Table 1**, approximately 70% of the calves that are lost between birth and weaning are born dead or die within 24 hours of birth. Most of these losses are related to calving difficulty. Research at the U.S. Meat Animal Research Center (MARC) in Clay Center, Neb., has shown that calves that experience calving difficulty are about four times as likely to be born dead or die within 24 hours of birth than those born without difficulty (16 vs. 4%). In two separate MARC studies that involved several thousand cows, 20% and 11.7% of those calves that experienced difficult births died, while 5% and 3% of those born unassisted died. Montana researchers observed that 57% of all calf losses in research herds were due to dystocia, while a summary of Michigan cow/calf producer records indicated that 67.6% of all calf losses were related to dystocia. Clearly, minimizing dystocia would improve calf survival rate in virtually all herds.

Dystocia also contributes to delayed rebreeding. In the Nebraska study, 54% of cows that experienced calving difficulty bred back during a 45-day AI breeding season, while 69% of unassisted cows did. Including the clean-up period, pregnancy rates were 69 and 85% for assisted and unassisted cows, respectively. Services per conception were similar between treatments. This indicates that calving difficulty caused delayed return to estrus, not less fertile estrus periods.

Table 1. Factors that reduce calf crop percentage

Factor	Percent
Cows fail to become pregnant	17.4
Calves lost during gestation	2.3
Calves lost at birth	6.4
Calves lost birth to weaning	2.9
Total losses	28.9
Net calf crop percentage	71.1

UNDERSTANDING THE CAUSES OF DYSTOCIA

Many factors influence the incidence of dystocia, including:

- Age of dam
- Calf birth weight
- Dam's pelvic area
- Sex of calf
- Size of the dam
- Gestation length
- Breed and genotype of sire
- Breed and genotype of dam
- Condition of dam
- Nutrition of the dam
- Shape of the calf
- Position or presentation in the uterus
- Geographic conditions
- Other unknown factors

Most of these factors can be grouped into two classifications:

- Factors affecting size and shape of the calf
- Factors affecting the ability of the dam to give birth

The interaction between these groups of factors determines the incidence of dystocia. In general, dystocia occurs when the size of the fetus is incompatible with the size of the pelvic opening of the cow, when the fetus is abnormally presented (breech birth, head or foot back, etc.), or when the cow does not experience normal parturition due to weakness, stress or hormonal abnormalities. By far the most common cause is the fetus is too large or the cow is too small. However, much can be done to ensure that fetus size is compatible with the opening of the cow's pelvis.

Age of dam. First-calf heifers account for the majority of calving difficulty and associated calf losses. This is true despite the fact that most first-calf heifers are observed more closely, and assisted more readily at calving than mature cows. High rates of dystocia among first-calf heifers and young cows are mostly due to the fact that they are smaller at first parturition than at subsequent calvings. However, other factors may contribute. Among these are the fact that the pelvic opening changes slightly in shape as the first calf is born, and that many of the females that experience calving difficulty as two-year-olds are culled.

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Table 2. Effect of age of dam on incidence of calving difficulty

	Location	
	Nebraska	Colorado
Age of Dam	Percent Calving Difficulty	
2 yr	54	30
3 yr	16	11
4 yr	7	7
5 and older	5	3

Note in **Table 2** the effect of age of dam in herds in two locations (MARC and Colorado State University), with differing incidences of dystocia. The difference in incidence of dystocia between the two locations is probably a result of mating to larger, exotic breed sires at MARC, while the CSU cows were mated to British breed sires.

Calf birth weight. The emphasis on increased weaning weight and growth rate, and resultant increase in frame size in the past few decades has resulted in dramatic increases in the birth weights of beef calves. Typically, calf birth weight is highly related to incidence of dystocia. **Table 3** includes data to describe this.

Table 3. Effect of birth weight on ease of calving in percentage Simmental females, Virginia

	Unassisted birth	Hand pull	Mechanical pull	Caesarean
Number of females	68	34	16	2
Percentage of total	57	28	13	2
Birth weight (lb)	81	88	100	121

Among dams of similar age (in this case all were two years old), birth weight of the calf is the trait most highly correlated with incidence of dystocia (**Table 4**).

Table 4. Effect of various traits on dystocia in Hereford and Angus heifers, Montana

	Breed of dam	
Trait	Hereford	Angus
Calf's birth weight	.54	.48
Sex of calf	-.47	-.26
Pre-calving pelvic area	-.18	-.22
Pre-calving weight of dam	-.01	-.20
Gestation length	.25	.10

Note: correlations of 1.0 or -1.0 are perfect correlations, reflecting direct cause and effect situations. A negative number means a smaller measure for the trait (such as pre-calving pelvic area) correlates with a higher incidence of dystocia. In this example, the nearer a correlation is to1.0 or -1.0, the greater the influence that the trait has on dystocia. A correlation of 0.0 indicates that two events are unrelated.

Birth weight is related to length of gestation. Birth weight will increase .3-.1.0 lb/day near the end of gestation. As birth weight increases, the percentage of assisted births will increase .7-2.0% per pound of birth weight.

The effect of birth weight on dystocia should be thought of as a "threshold" type of effect. In other words, while reducing birth weight will reduce the incidence of calving difficulties in some herds, beyond a certain point, continuing to reduce birth weight will not continue to reduce dystocia, within a given cow size. Put another way, in a herd that has little trouble calving, increasing birth weight slightly will increase dystocia, but after a while dystocia will be at a high rate and will only increase further with large increases in birth weight.

The point where birth weight is just large enough that a slight increase will substantially increase dystocia is called the threshold. Since birth weight is highly correlated to growth traits, a producer may strive to "challenge" his/her cows by choosing matings that will result in birth weights near the threshold in that particular herd. This practice will keep dystocia at a manageable level and result in maximum calf performance.

Breed of sire. Research has shown that birth weight does not account for all of the variation in dystocia among groups of calves out of similar cows.

The obvious implication of this is that differences in calf shape or some other calf-related factor would also account for variation in incidence of dystocia. While data to clearly prove this theory are difficult to obtain, few cattlemen would dispute that calf shape affects ease or difficulty of birth. Research in Germany has demonstrated a high correlation between chest girth at 330 days of age in Simmental sires and calving difficulty of their subsequent progeny. An extreme example would be the relatively high incidence of calving difficulty occurring in some of the double muscled beef breeds, or double muscled bloodlines within breeds that have the trait. It is commonly thought that cattle that are smooth in appearance (smooth, correct shoulder placement, absence of coarse muscling) sire calves that are born more easily than the opposite type, even if birth weights do not differ. While this is likely true, some breeders have taken this to extremes, which has reduced productivity in other ways.

Table 5. The effect of breed of sire on birth weight and calving difficulty

		Calving difficulty, %	
Breed of sire	Birth wt. lb	All ages	2-yr-old cows
Hereford-Angus	74	11	41
Jersey-X	66	5	15
South Devon-X	79	27	68
Limousin-X	80	24	72
Charolais-X	85	34	74
Simmental-X	84	29	66

Calves were produced by mating Hereford and Angus cows to Hereford, Angus, Jersey, South Devon, Limousin, Charolais and Simmental sires. Data are adjusted to similar cow age and equalized for sex differences.

Table 6. The effect of breed of dam on calving difficulty

Breed of cow	Percent assisted births
Cycle 1 (2- through 8-yr-old cows)	
Hereford-Angus-X	10
Jersey-X	4
Limousin-X	9
South Devon-X	12
Simmental-X	14
Charolais-X	12
Cycle 2 (2- through 7-yr-old cows)	
Hereford-Angus-X	17
Red Poll-X	19
Brown Swiss-X	11
Gelbvieh-X	15
Maine-Anjou-X	15
Chianina-X	11
Cycle 3 (2- through 5-yr-old cows)	
Hereford-Angus-X	19
Tarentaise-X	14
Pinzgauer-X	19
Sahiwal-X	4
Brahman-X	3

Breed of dam. **Table 6** includes data from several years of research at MARC that characterized F1 half-blood cows of several breeds, all of which were out of purebred Hereford or Angus cows. In general, half-blood cows of most breeds did not differ from Hereford x Angus cows, which were used as controls in each cycle of the experiment. However, Jersey, Brahman and Sahiwal (a Zebu breed) F1 cows did experience slightly less calving difficulty than the other crosses. Other research supports the conclusion that dairy and Zebu breeds require less assistance at calving. Two-year-old dairy x beef females experienced 21% calving difficulty compared with 37% for beef x beef females in an Oklahoma study. Differences among breeds of dam are most likely due to differences in relative pelvic area, muscling or fatness.

Dam's pelvic area. Pelvic area has received considerable attention recently as a trait that is related to dystocia. However, not all researchers agree on the importance of this trait. Research at South Dakota State University has shown that the incidence of calving difficulty is more than twice as high in heifers with below average pelvic areas, compared with above average. In an Oklahoma study, 85% of heifers with small pelvic areas experienced calving difficulty, while 31% of heifers with large pelvic areas had difficulty. **Table 7** describes the relationship among pelvic area of heifers, birth weight and incidence of dystocia. These estimates result from calculations based on data collected from calving 600 first-calf heifers.

Just like birth weight, pelvic area is a threshold trait. If the pelvic area of a female is large enough for the calves that she will have, there would be no advantage in a larger pelvis. Work in Canada supports this conclusion (**Table 8**). Records of 547 two-year-old cows of three breed types were analyzed and pelvic area contributed only slightly to explaining the calving difficulty that occurred. In this study, however, the average pelvic area of the females was extremely large. Note that while pelvic area was not an important factor, the ratio of birth weight/pelvic area was an extremely important factor. Since the pelvic area of all females was large, birth weight, dam weight and the ratio of those traits were the most important factors.

Note also that the ratio of birth weight/dam's hip height was virtually unrelated to calving difficulty. This brings up another point. Although pelvic area is highly correlated to frame size (large cows have large pelvises), the correlation is not perfect. There are **no external measurements** that accurately predict pelvic area. Pelvic area should be directly measured. It should not be assumed that all large-framed females will have large pelvises or that all small females will have small pelvises. An example of this is the Jersey breed. Jerseys are small cattle that have very large pelvises, compared with other breeds of similar size.

A Nebraska scientist has estimated the weight of calf that can be delivered by heifers without requiring assistance, based on their pelvic area (**Tables 9, 10**). In general, heifers with a pelvic area/birth weight ratio of 2.1 or greater (pelvic area measured at breeding) required little or no assistance, while all of those with ratios of 1.9 or less experienced difficult births. Thus, a heifer with a pelvic area of 140 cm at breeding could deliver a 67-lb calf, if pelvic area was 160, 76 lb, if

Table 7. Relationship among heifer pelvic area, calf birth weight and incidence of dystocia, %, Montana

	Pelvic area (cm^2) at calving				
	210	230	250	270	290
Birth wt, lb	--------Incidence of dystocia, %----------				
55	47	32	19	8	0
65	78	62	48	37	28
75	100	88	74	62	52
85	100	100	96	83	73
95	100	100	100	100	90

Table 8. Correlations between various traits and incidence of calving difficulty in first-calf heifers, Alberta

Trait	Correlation
Calf birth wt	.47 **
Sire birth wt	.05
Dam birth wt	.09 *
Dam wt at calving	-.19 **
Calf birth wt/dam wt at calving	.52 **
Dam condition	-.08 *
Dam's pelvic area	-.07
Calf birth wt/dam's pelvic area	.46 **
Calf birth wt/dam's hip height	-.01

* = significant correlation; ** = highly significant correlation
See note under Table 4.

Table 9. Using pelvic measurements to estimate deliverable calf size, Nebraska

Time of measurement	Pelvic area cm^2	Pelvic area/ birth wt ratio	Deliverable birth wt, lb
Before breeding	140	2.1	67
	160	2.1	76
	180	2.1	86
Pregnancy exam	180	2.7	67
	200	2.7	74
	220	2.7	82

180, 86 lb. If pelvic area is measured at time of pregnancy exam, a ratio of 2.7 should be used. As shown in **Table 10**, if a group of heifers varies widely in age at time of measurement, various ratios should be used.

These data are interesting in explaining dystocia, but may be of little practical value to producers, since birth weights cannot be predicted. Nonetheless, a producer who has an idea of what the birth weights will average in his herd can use these guidelines.

The bottom line on pelvic area is this: females with very small pelvises that carry large calves will experience calving difficulty every time, no exceptions. On the other hand, females with large pelvises that have small calves will have very low (but probably not zero) incidence of calving difficulty. Since pelvic area is highly heritable (estimates average 55%), producers who would like to reduce the incidence of dystocia in their herds should select **against** small pelvises (this is not the same as selecting **for** large pelvises, which may not be required). In some herds, this will produce dramatic improvements; in others there will be little effect. In two large purebred herds, culling of heifers with small pelvises has reduced dystocia among two-year-old females to 4-5%. In these herds, as many as 10% of replacement heifers were culled due to inadequate pelvic area in the first few years of using pelvic measurements. However, after a few years, very few females failed to meet pelvic area selection criteria. Producers who would like to reduce the incidence of calving difficulty in their herds should consider pelvic measurements.

Table 10. Pelvic area/calf birth weight ratios for various heifer weights and ages to estimate deliverable calf birth weight, Nebraska

Heifer weight, lb	------Age at measurement, months------ 8-9	12-13	18-19	22-23
500	1.7	2.0	—	—
600	1.8	2.1	—	—
700	1.9	2.2	2.6	—
800	—	2.3	2.7	3.1
900	—	2.4	2.8	3.2
1000	—	2.5	2.9	3.3
1100	—	—	—	3.4

Table 11. Effect of precalving energy intake on calf birth weight (BW) and incidence of calving difficulty (CD), Nebraska

	----------Precalving energy intake----------					
	Low		Medium		High	
Breed	BW	CD	BW	CD	BW	CD
Hereford	57	29	62	20	66	25
Angus	58	23	61	13	62	12
Average	58	26	61	17	64	18

TDN intake was 10.8, 13.6 and 16.9 lb/hd/day. ADG was .6, 1.4 and 2.0 for 90 days prior to calving.

Pre-calving nutrition and condition of the dam. Some cattle producers feel that limiting the feed that cows get prior to calving will reduce calf birth weight and dystocia. Research at MARC has shown that while birth weight can be reduced due to limited cow nutrition, calving difficulty is actually **increased** in the underfed cows with the lighter calves (**Table 11**). Since underfeeding cows prior to calving will also delay return to estrus, this practice should be avoided.

Abnormal presentation or delivery. Most calves are presented with the front feet first and the nose resting on the front legs. Occasionally, the fetus will be backwards, breech (buttocks first), head to one side or the other, or have one or both front legs back or a knee bent. Often, large calves will result in hip or shoulder lock. These abnormal presentations usually require some degree of assistance. Although abnormal presentations are thought to be repeatable (cows that have an abnormally presented fetus once are more likely to do so again), there is little that can be done to reduce the relatively small percentage of calves that experience dystocia due to abnormal presentation.

Development of replacement heifers. The simplest way to avoid the high incidence of dystocia in first-calf heifers is to not calve any. However, purchasing only mature replacement females is seldom feasible or desirable. Thus, most cattle producers will regularly calve a group of first-calf heifers despite the expected calving troubles. There are strategies that will reduce dystocia in first-calf heifers. Replacement heifers must be fed to grow and develop rapidly enough so that they cycle and become pregnant early enough to calve at 24 months of age. A further advantage of this is that they will be as close to their mature skeletal size as possible when they calve for the first time. This will help to reduce calving prob-

Table 12. Effect of pre-calving energy level on birth weight and dystocia in 2-year old cows, MARC

Energy level	Birth wt, lb	Dystocia, %
Low (10.8 lb TDN)	58	26
Medium (13.7 lb TDN)	62	17
High (17.0 lb TDN)	64	18

Table 13. Effect of pre-calving energy level on birth weight and dystocia in 2-year old cows, Montana

Energy	Cow wt. lb	BW, lb	Dystocia, %
Low (7.5 lb TDN)	725	59	40
High (13.9 lb TDN)	811	63	36

lems. As a rule of thumb, heifers should weigh at least 65% of their expected mature weight at time of first breeding, and 85% of mature weight at first calving. Weigh heifers occasionally and adjust diets to produce desired gains without making heifers too fat.

Use of hormonal growth-promoting implants in development of replacement heifers is a controversial topic because some research results are conflicting. Studies have indicated that use of implants in heifer calves increased pelvic area, but in many cases, pelvic area was increased at yearling or breeding but not at first calving. Thus, there was no calving ease benefit. Results of a recent study conducted at the University of Nebraska suggest that implanting at 6 (or 2 and 6) months of age increases pelvic area at calving, while implanting at 2 months of age does not. More study is necessary before solid recommendations are possible, and factors other than pelvic area should be considered when deciding whether or not to implant potential replacement heifers.

REDUCING DYSTOCIA

Producers need to consider both genetics and management in attempts to reduce dystocia. An important management practice is to mate heifers so that they calve earlier in the season than cows. This makes it possible to give the heifers extra attention. Also, feed cows properly according to nutrient requirements and condition scores. In addition, know when and how to give calving assistance and when to call a veterinarian.

Genetic solutions are more complicated. Birth weight is the trait of most interest. When possible, consider the birth weight Expected Progeny Difference (EPD) in bull selection. EPD's have been shown to be more accurate indicators of performance, including birth weight, than actual performance data. Although specific guidelines are impossible to give for all situations, some general recommendations apply. Remember that the average BW EPD in each breed differs. A bull with a 0.0 lb BW EPD in one breed may sire calves with vastly different birth weights than a bull with a 0.0 lb BW EPD in another breed. Do not be as concerned with the exact numbers, which may change from one year to the next, as with the bull's rank within the current or active sires within the breed. **Table 15** includes guidelines for selecting bulls based on the current sires list within breeds. For example, small to moderate-sized heifers should be mated to bulls of moderate-sized breeds with BW EPD's that rank the bulls in the lower 1/2 of the breed, or only to the lowest 10% of large-breed bulls. **Table 16** includes averages and ranges in BW EPD for several breeds.

Birth weight is not the whole story, however. Some breeds also calculate a Calving Ease EPD, which is highly related to BW EPD, but actually a better predictor of calving ease. Some breeds also calculate a Maternal Calving Ease EPD. This is an indication of the ease with which the daughters of a bull will give birth, when they are old enough to calve. This is a particularly important consideration, since birth weight and growth performance are highly correlated. If low BW EPD bulls are used for several generations, the growth performance of a herd could suffer, due to this correlation. Also, the subsequent daughters may be more susceptible to dystocia than their dams, due to small size. Thus, if bulls can be identified that will calve easily, and produce daughters that calve easily, dystocia will be reduced, not just postponed until the next generation.

BW EPD's and Calving Ease EPD's, as traditionally calculated, can be quite useful in reducing dystocia, but do

Table 14. Recommended weight of replacement heifers at breeding and first calving, by expected mature weight

Expected mature weight	Weight at breeding	Weight at first calving
900	585	765
1000	650	850
1100	715	935
1200	780	1020
1300	845	1105
1400	910	1190

Table 15. Guide for selecting bulls within breeds based on current sire list

Type of female	Moderate size breed bull	Large breed bull
Small to moderate heifer	Lower 1/2	Lowest 10%
Large heifer	Lower 2/3	Lower 1/2
Small to moderate cow	Lower 2/3	Lower 2/3
Large cow	No restriction	Avoid extremes

Table 16. Breed mean and range in birth weight EPD values of current (or active) sires in several breeds

	BW EPD		
Breed	Low	High	Average
Angus	- 9.2	+12.8	+1.3
Gelbvieh	-15.8	+16.4	+0.3
Limousin	- 6.5	+ 7.0	+0.5
Polled Hereford	-12.7	+12.4	+2.8
Saler	- 4.7	+ 5.8	+0.2
Simmental	-10.1	+ 9.3	+0.1
Shorthorn	- 4.7	+ 6.7	+0.8

1989 or 1990 sire summary values

not answer all of the important questions. The American Simmental Association has begun using a threshold model to calculate Calving Ease EPD's. Use of this model reflects the fact that increases in birth weight result in nonlinear increases in incidence of calving difficulty, as described previously. Calving Ease EPD's are then reported by ASA as the deviation from the average in the percentage of assisted births that use of a sire will cause. Separate EPD's are calculated for each bull reflecting his ease of calving in both mature cows and first-calf heifers.

If EPD's are not available, consider the actual birth weight of a bull. While not as accurate as an EPD, the actual birth weight is useful, since birth weight is moderately heritable. Consider the age of a bull's dam, as it will affect his birth weight. Actual birth weights should be adjusted to a "mature dam equivalent." For bull calves out of two-year-old dams, add 8 pounds to their birth weight; out of three-year-old dams, add 5 pounds; out of four-year-old dams, add two pounds; out of 5-10-year-old dams, no adjustment; out of 11-year-old dams and above, add 3 pounds.

SUMMARY

Here are some general recommendations to reduce dystocia:

- Mate virgin heifers and small cows to bulls that will sire small calves. Consider breed, birth weight Expected Progeny Difference, actual birth weight and physical structure of the bull when making mating decisions.
- Feed heifers well enough to weigh at least 85% of their expected mature weight at first calving.
- If calving difficulty is a problem in your herd, measure pelvic area in replacement heifers and cull those that are too small. Required size will differ from one breed to the next. In general, however, heifers of medium-sized breeds should have pelvises of at least 160 square centimeters at breeding; those of large breeds, 180 or more.
- Do not retain daughters of cows that have a record of calving difficulty.
- Begin breeding heifers 21 to 30 days earlier than cows so you can observe heifers more at calving time. Feed the herd late in the day during calving season so that more will calve in daylight.
- Record a calving ease score for all calves you observe at birth. If calving ease or difficulty changes over time, consider reasons for this.

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