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Genetic Aspects of Calving Ease

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Several trends in cattle production and marketing are becoming evident. Leaner and perhaps heavier muscled slaughter cattle will be in demand through the chain from consumers back through retailers, packers, feeders and finally the producers. Emphasis on growth in the feedlot will continue. Thus, the feedlot and carcass characteristics desired point towards fairly large, heavier muscled cattle. At the producer level, increased emphasis is being placed on matching cow size, milk level, and overall biological type to available resources. Thus, the trend for maternal herds in the Great Plains point towards an adapted, probably moderate size, and milking cow that excells in reproduction. Various forms of crossbreeding will be the major breeding system. The combination of these trends will encourage the greater use of terminal sires crossed on smaller, adapted cow herds. Thus, calving ease will continue to be of great importance.

Given the above scenario, the breeding values or expected progeny difference (EPD) values for sires needed for maternal (female replacements) versus terminal (slaughter progeny) biological types may be quite different.

This presentation will discuss some of genetic aspects of factors affecting calving ease. Specifically, we will look at birth weight, gestation length and pelvic measures along with calving ease score.

Calving Ease

Calving difficulty influences the economics of the cow herd through calf losses, increased labor or veterinary costs, poorer subsequent reproductive efficiency of the dam and occasional cow losses. Thus, calving ease is an important economic trait.

Most breed associations and research stations use the calving ease scoring system recommended by the Beef Improvement Federation (Table 1). Scores of 1 through 4 are used in analyses of calving ease data.

Table 1. Calving Ease Scoring System

Score	
1	No difficulty, no assistance
2	Minor difficulty, some assistance
3	Major difficulty, ususally mechanical assistance
4	Caesarean section or other surgery
5	Abnormal presentation

The genetic influence on calving ease can be divided into a direct component and a component due to maternal effects. Expected progeny difference values in sire summaries published by breed associations usually list values for both calving ease direct and calving ease total maternal (one-half direct plus maternal values). The EPD direct value is the average calving ease score we expect on the progeny of a sire. The EPD total maternal value is the average calving ease score we expect daughters of a sire (maternal grandsire of calves) to produce during parturition. The direct EPD value for sires is due primarily to birth weight, gestation length and shape of calf associated with sire effects. The total maternal EPD value would include these factors plus size of the heifer, pelvic dimension and other maternal factors. The EPD values reported in most sire summaries are those associated with 1st calf calving ease since that is where most problems exist and because breeders are interested in selecting specific sires to breed to heifers.

The heritability estimates for direct and maternal 1st calf calving ease reported by some of the breed associations are listed in Table 2.

Table 2. Heritability Estimates for First Calf Calving Ease

Breed	Direct	Maternal
Simmental	.07	.07
Polled Hereford	.37	.10
Gelbvieh	.47	.60

Considerable variation exists among these estimates and it appears that the genetic influence on this trait may vary widely among breeds.

Birth Weight

Birth weight is probably the most important factor affecting direct calving ease. Heritability estimates (Table 3) from breed association data indicates that this trait is fairly highly heritable.

Table 3. Heritability Estimates for Birth Weight

Breed	Estimate
Simmental	.09
Polled Hereford	.56
Gelbvieh	.56
Red Angus	.46
Charolais	.52

With emphasis on increased growth over the past decade, one would expect correlated increases in birth weights.

Gestation Length

The genetic makeup of the calf plays an important part in triggering parturition and therefore gestation length. The heritability estimates indicate that gestation length is highly heritable (Table 4). However, the trait does not show much total variation and therefore large changes are not expected through selection.

Table 4. Heritability Estimates for Gestation Length

Breed	Estimate
Simmental	.37
Gelbvieh	.64

Genetic Correlations Among Factors Affecting Calving Ease

Genetic correlation estimates among factors affecting calving ease and correlations with calving ease from breed association data are listed in Table 5. The genetic relationship between birth weight and calving

Table 5. Correlations with Calving Ease

Trait	Gestation Length	Calving Ease
Birth Wt.		
Simmental	.26	.40
Gelbvieh	.16	.45
Polled Hereford		.60
Gestation Length		
Simmental		.26
Gelbvieh		.20

ease is fairly high (.40-.60) indicating that as birth weight increases problems with calving increase. Genetic relationships between birth weight and gestation length are lower (.16-.26) as are those between gestation length and calving ease (.20-.26).

Pelvic Measures

There has been considerable interest in and some research on pelvic measures recently as related to improving calving ease. Most studies have worked with yearling heifers and in some cases, yearling bulls. As with most anatomical measures that can be measured accurately, these studies have shown pelvic measures to be highly heritable with fairly large breed differences in size and shape.

Pelvic area of mature cows may be important when moderate size cows are mated to terminal sire type bulls. A recent Colorado study indicates that pelvic measures continue to increase through five years of age (Table 6). There is a large increase

Table 6. Least Squares Means by Age of Cow and Breed for Pelvic Measures (cm)

Source	No.	Height	Width	Area
Age of cow				
1	203	13.1	11.5	157
1.5	104	15.9	13.8	220
2	55	18.5	16.3	300
3	44	19.9	17.4	341
4	30	20.4	17.7	357
5+	123	20.7	18.2	373
Breed				
Angus	45	18.7	15.6	298
Brangus	25	19.2	15.7	300
Hereford	330	17.4	15.3	272
Red Angus	44	18.3	15.7	294
Simmental	11	17.1	16.8	293

in pelvic measures between one and two years of age (after calving) with more gradual increases from two through 5+ years of age.

Breed differences were also apparent with the Angus and Brangus having the largest pelvic area (height x width) and Herefords having the smallest pelvic area. Brangus had the largest height measurement whereas the Simmental had the largest width measurement and tended to be more square in shape.

Heritability estimates for pelvic measures obtained from the Colorado study for cows, heifers and yearling bulls, both on an age adjusted and on a weight adjusted basis are listed in Table 7.

Table 7. Heritability Estimates for Pelvic Measures

Source	Height	Width	Area
Age Adjusted			
Cows	.79	.78	.92
Heifers	.83	.19	.56
Bulls	.45	.16	.40
Weight Adjusted			
Cows	.76	.83	.91
Heifers	.74	.09	.47

Heritability estimates were generally high except for the width measures for yearling heifers and yearling bulls. Heritability estimates for pelvic height were consistently high. It is interesting to note that heritability estimates from data adjusted for differences in body weight are only slightly lower than those adjusted for age differences suggesting considerable genetic variation in pelvic dimensions not associated with weight differences. Analyses using hip height instead of body weight yielded similar results. Thus, it appears that taking pelvic measures instead of relying solely on weight and skeletal size is justified. These estimates of pelvic measures are somewhat higher than other estimates in the literature.

The estimates of genetic correlations between height and width were moderate values being .29 in the cow analysis and .23 in the heifer analysis. Height was more highly genetically correlated with area (HxW) than was width since it is a somewhat larger dimension. Genetic correlation estimates of height with area were .86 and .93 in the cow and heifer analyses whereas corresponding values between width and area were .73 and .58.

Estimates of genetic correlations between pelvic measures in yearling bulls with pelvic measures of half-sib yearling heifers were also obtained and are listed in Table 8.

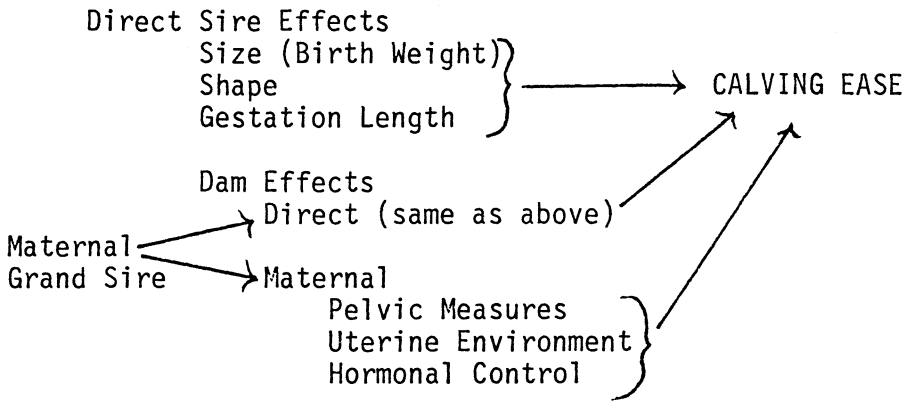
Table 8. Genetic Correlation Estimates Between Male and Female Pelvic Measures

Female	**Male**		
Age Adjusted	Height	Width	Area
Height	.74	.24	.50
Width	.78	.38	.62
Area	.83	.28	.60
Weight Adjusted			
Height	.63	.36	.47
Width	.72	.51	.62
Area	.72	.49	.60

Most genetic progress is made through sire selection and therefore a measure in yearling bulls which would predict measures in female offspring would be useful. Pelvic height in yearling bulls appears to be such a measure as it appears to be highly correlated with female height, width and area on both an age or weight adjusted basis. Selection for increased male pelvic height should result in correlated increases in pelvic dimensions of female offspring. If female pelvic dimensions are increased and birth weights of offspring are held constant, it seems logical to expect improvement in maternal calving ease.

Discussion

A diagram showing the factors affecting calving ease from a genetic standpoint is shown below.



For terminal sires where all offspring are slaughtered, only the direct sire effects are important in selecting sires for use on a given cow herd. The emphasis to be placed on these factors would be determined by cow size and the maternal calving ease attributes of the cow herd.

In selecting sires for use in producing replacement heifers, both direct sire effects and maternal calving ease should be considered. Emphasis should be placed on developing a cow herd with excellent total maternal calving ease (one-half direct + maternal). Expected Progeny Difference values for some of these factors in some sire summaries are available. An example taken from the 1987 Gelbvieh Sire Summary is shown below (Table 9.)

Table 9. Information in Gelbvieh Sire Summary on Calving Ease

	Birth Wt.	Weaning Wt.	Yrl. Wt.	Milk	Total Mat	Gest. Lgnt.	Calving Ease Direct	Calving Ease Daugh.
Sire 1								
EPD	2.5	36.6	43.4	-10.1	8.1	0	-.05	-.09
Acc.	.79	.78	.71	.65		.76	.79	.68
Sire 2								
EPD	1.7	14.1	7.6	4.0	11.1	-1.8	-.01	-.01
Acc.	.73	.73	.71	.69		.75	.74	.71

In addition, pelvic measures of yearling bulls and replacement heifers, especially pelvic height, appear to be promising to increase pelvic area and thus enhance maternal calving ease.

In summary, calving ease will continue to be important as the industry produces fast growing, muscular progeny by terminal sires. Terminal sires should be selected on measures of direct calving ease by using EPD values for calving ease and birth weight and by monitoring gestation length-avoiding those with long gestation length.

To accomodate fairly heavy birth weights, emphasis should be placed on developing a cow herd that excells in maternal calving ease. Sires of replacement females should be selected to maintain cow size and milk production levels compatable with resources. In addition, they should be selected on EPD values for total maternal calving ease along with gestation length. Pelvic measures, especially height, on yearling bulls should also be useful in improving maternal calving ease of replacement feamles.