Montana yearling beef heifers bred to Simmental and Angus sires selected for decreased dystocia
by Harv Casey Van Wagoner

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Animal and Range Sciences
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Abstract:
The objective of this study was to compare birth weight, gestation length, calving ease and percent assisted births of calving ease Simmental and low birth weight Angus sires. Angus yearling heifers were bred in two consecutive years (1999 and 2000) at four locations by AI using Simmental (S; n = 20) and Angus (A; n = 27) semen. Birth weights, gestation lengths, and calving ease scores (1 = unassisted, 2 to 4 = various levels of assistance) of 1,039 calvings in 2000 and 2001 were analyzed to determine sire breed effect. Calving ease scores were recorded so that the percentage of assisted births could be calculated. The statistical model included the fixed effects of year of birth, sire breed, calf sex, ranch, two-way, and three-way interaction. Sire breed affected ($P < 0.01$) birth weight, gestation length, and percent assisted. Simmental sired calves were 2.13 ± 0.37 kg heavier at birth and 2.90 ± 0.48 days longer in gestation length than Angus sired calves. Simmental sired calves were assisted 1.44 more times than Angus sired calves. Sire breed by calf sex by year affected ($P < 0.01$) calving ease score. In both years Simmental sired bull calves had the highest ($P < 0.01$) calving ease score. Angus bull calves had a greater calving ease score than Simmental or Angus heifer calves in 2000, but no difference was detected between Simmental or Angus sired heifer calves. In 2001, Angus sired bull calves had a higher ($P < 0.05$) calving ease score Angus heifer calves, but not different ($P > 0.05$) from Simmental sired heifer calves. No differences ($P > 0.05$) were detected between Simmental or Angus sired heifer calves for calving ease. Calf sex affected ($P < 0.01$) birth weight and gestation length. Bull calves were 2.77 ± 0.25 kg heavier at birth and 1.30 ± 0.27 days longer in gestation length than heifer calves. Furthermore, bull calves were assisted 2.51 and 1.36 times more than heifer calves (2000 and 2001, respectively). In this study calf sex is the leading cause of dystocia followed by sire breed.

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This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding contents, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

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ABSTRACT

The objective of this study was to compare birth weight, gestation length, calving ease and percent assisted births of calving ease Simmental and low birth weight Angus sires. Angus yearling heifers were bred in two consecutive years (1999 and 2000) at four locations by AI using Simmental (S; n = 20) and Angus (A; n = 27) semen. Birth weights, gestation lengths, and calving ease scores (1 = unassisted, 2 to 4 = various levels of assistance) of 1,039 calvings in 2000 and 2001 were analyzed to determine sire breed effect. Calving ease scores were recorded so that the percentage of assisted births could be calculated. The statistical model included the fixed effects of year of birth, sire breed, calf sex, ranch, two-way, and three-way interaction. Sire breed affected ($P < 0.01$) birth weight, gestation length, and percent assisted. Simmental sired calves were 2.13 ± 0.37 kg heavier at birth and 2.90 ± 0.48 days longer in gestation length than Angus sired calves. Simmental sired calves were assisted 1.44 more times than Angus sired calves. Sire breed by calf sex by year affected ($P < 0.01$) calving ease score. In both years Simmental sired bull calves had the highest ($P < 0.01$) calving ease score. Angus bull calves had a greater calving ease score than Simmental or Angus heifer calves in 2000, but no difference was detected between Simmental or Angus sired heifer calves. In 2001, Angus sired bull calves had a higher ($P < 0.05$) calving ease score Angus heifer calves, but not different ($P > 0.05$) from Simmental sired heifer calves. No differences ($P > 0.05$) were detected between Simmental or Angus sired heifer calves for calving ease. Calf sex affected ($P < 0.01$) birth weight and gestation length. Bull calves were 2.77 ± 0.25 kg heavier at birth and 1.30 ± 0.27 days longer in gestation length than heifer calves. Furthermore, bull calves were assisted 2.51and 1.36 times more than heifer calves (2000 and 2001, respectively). In this study calf sex is the leading cause of dystocia followed by sire breed.

CHAPTER 1

INTRODUCTION

Problems associated with beef cattle production are numerous and in many cases costly. Reproductive failure and resulting consequences account for an estimated annual loss of 750 million dollars (Colburn et al., 1997). Improvement in reproduction can come through selection; however, most improvement must come as a result of changes in environment or management. Therefore, reproduction can be improved rapidly due to the ability of management to change quickly. Scientific information necessary to improve reproductive performance of beef cattle is readily available, yet a large proportion of ranchers do not apply most available information. The intent of this thesis, will be to compare incidents of dystocia between Angus and Simmental sires, in commercial heifer mating programs.

CHAPTER 2

REVIEW OF LITERATURE

Dystocia

Dystocia, defined as delayed and difficult birth, directly impacts reproductive efficiency in two-year-old cows. Economics of a cow herd are influenced by calf losses, increased labor costs, reduced subsequent reproductive efficiency of the dam and cow losses due to calving difficulty (Wiltbank, 1994). Sloss (1974) reported that 21.3% of all dystocia cases suffered parturient or post-parturient conditions. Laster et al. (1973) reported an incidence of dystocia in 2-yr-old cows 36% higher than 3-yr-olds and 45% higher than 4- and 5-yr-olds. Thomas (1992) noted, that 68% of all calf deaths were three days postpartum, of which 61% of the deaths resulted from dystocia. Calving data, were compiled over 15 years and consisted of 13,000 observations, at the Livestock and Range Research Station at Miles City, MT. Thus, dystocia represents the largest cause of calf losses.

Data from the dairy industry demonstrates the adverse effects of dystocia. Primiparous cows experienced losses in 305-d adjusted milk, fat, and protein yields following a birth requiring assistance (Djemali et al., 1987; Dematawewa and Berger, 1997). Furthermore, Dematawewa and Berger (1997) found losses in the three yield traits, days open, and cow deaths increased steadily as calving difficulty increased.

Birth weight

Birth weight of the calf is one of the leading factors in the occurrence of dystocia (Bellows et al., 1971; Cook et al., 1993; Colburn et al., 1997), with the single largest source of dystocia being fetal oversize and/or extremes in birth weight (Rice and Wiltbank, 1970; Nelson and Huber, 1971). Furthermore, severity of dystocia is dependent upon weight of the calf relative to that of it's dam (Sagebiel et al., 1969), with heavier calf birth weight being a function of increased soft tissue, not skeletal size (Laster, 1974). Thus, increases in calving difficulty, in relation to increasing birth weight of the calf, have been noted (Naazie et al., 1989) among and within breed groups (Smith et al., 1976), with 4.2% increases in percentage assisted birth for each kg increase in birth weight (Gregory et al., 1991).

Birth weight of the calf is related to its genotype and sex, age, and gestation length of the dam (Laster, 1974; Bellows, 1976). Cattle selected for faster growth rate results in increased birth weight of the calf, which is shown by the positive genetic correlation between weaning and yearling weights to weights recorded at birth (Gregory et al., 1950). Furthermore, birth weights are higher in the northern United States than in the southern United States (Burns et al., 1979; Burfening et al., 1987).

Calf sex.

Calf sex has been reported as a cause of difficult calvings (Bellows et al., 1971), with bull calves exhibiting a higher frequency of dystocia than heifer calves (Young, 1968; Pattullo, 1973; Berger, 1994). Furthermore, Berger et al. (1992) found heifer calves to have 1.45 times greater chance to be delivered unassisted. Research also indicates that increases in dystocia levels related to the male are a function of higher mean birth weight and longer gestation length (Burris and Blunn, 1952 and Smith et al., 1976).

Gestation length.

Extended gestation length normally results in higher birth weights (Jafar et al., 1950; Burris and Blunn, 1952). Burfening et al. (1981) found a moderate genetic correlation between gestation length and assisted births in the American Simmental Association field records. Birth weight of calves increased 0.25 kg/d for each additional day of gestation, which resulted in an increase in percent assisted births of 0.70% per day of increased gestation length (Burfening et al., 1978). Bull calves exhibit a longer gestation length than heifer calves (Corah et al., 1975; Burfening et al., 1978; Notter et al., 1978). Mean gestation lengths differed between breeds (Burris and Blunn, 1952; Smith et al., 1976; Notter et al., 1978), but straight bred and cross bred calves were not different (Smith et al., 1976). Additionally, a low plane of nutrition can shorten gestation length (Kroker and Cummins, 1979).

Sire Breed.

Sire breed differences affect both dystocia score and birth weight (Laster, 1974; Nelson and Beavers, 1982; Gregory et al., 1991). Dystocia score of straight and crossbred calves did not differ (Laster et al., 1973); however, increased calving difficulty in crossbred heifer calves has been reported (Sagebiel et al., 1969). Gregory et al. (1991) concluded the effect of heterosis is not consistent for calving difficulty. Furthermore, crossbred calves are more likely to be heavier at birth than the averages of their parental breeds (Gaines et al., 1966).

A study conducted by Nelson and Huber (1971) found the breed of sire to be the second most important variable contributing to calving difficulty score, preceded by birth weight. However, calving difficulty score and calf birth weight were not correlated with sire birth weight, when sires were selected for low birth weights (Naazie et al., 1989).

Cow weight and pelvic area.

Pelvic area of the dam had a negative effect on calving difficulty score (Young, 1968; Young, 1970; Bellows et al., 1971), with pelvic area being more important in primiparous than multiparous cows when predicting dystocia (Thompson and Rege, 1984; Morrison et al., 1985). Larger dams, as measured by greater body weight have larger pelvic dimensions, therefore, larger pelvic areas (Bellows et al., 1971; Laster, 1974; Bellows et al., 1996). Leading to the conclusion that heavier dams require less assistance than lighter dams (Young, 1968; Nelson and Huber, 1973; Cadle, 1976). However, obese cows require more assistance at parturition than normal cows due to a decrease in pelvic size (Arnett et al., 1971).

Positive correlations, between birth weights and cow weights, were noted by Gregory et al. (1950) and Cook et al., (1993). Dystocia when correlated to pelvic size and other measurements describing cow size, condition and anatomy are too low to accurately predict dystocia in beef cattle (Laster, 1974). Therefore, selection of sires based on birth weight EPD is a much more effective tool than selection of replacement heifers based on pelvic area to reduce calving difficulty in first-calf-heifers (Cook et al., 1993).

Nutrition

Level of nutrition during gestation has little effect on calving difficulty (Bellows, 1976). Nutritional levels created a difference in the calf birth weight, length and hip width measurements (Kroker and Cummins, 1979), but no difference in the rate of dystocia were detected (Young, 1970; Corah et al., 1975; Bellows, 1976). However, obese cows, a result of higher nutrition levels, require more assistance at parturition than normal cows due to a decrease in pelvic area (Arnett et al., 1971). Pattullo (1973) noted a decrease in calf birth weight when dams were nutritionally challenged during the last trimester of pregnancy. Decreasing birth weight by restricting nutrition is nullified to some extent due to a simultaneous retardation of pelvic development (Kroker and Cummins, 1979), which is associated with a general retardation of skeletal growth (Young, 1970; Bellows, 1976; Kroker and Cummins, 1979). Furthermore, muscle tone may be compromised by low levels of nutrition and lead to a prolonged parturition (Kroker and Cummins, 1979).

Age of dam.

Dystocia score differences are attributed to parity of the dam, with the percent of total difficult calvings higher among heifers (Brinks et al., 1973; Wythes et al., 1976; Notter et al., 1978). Laster et al. (1973) reported an incidence of dystocia in 2-yr-old cows 36% higher than 3-yr-olds and 45% higher than 4- and 5-yr-olds. Dekkers (1994) reported the occurrence of hard pulls and surgery, in Canadian Holsteins, three times greater in primiparous than multiparous dams. Furthermore, age of the dam effects birth weight and gestation length (Gregory et al., 1991). Laster and Gregory (1973) found lower birth weights of calves born to primiparous than multiparous dams, though percentage of assistance was higher. Therefore, the effect of birth weight on calving difficulty is dependent upon the age of the dam (Smith et al., 1976).

Miscellaneous.

Year, season of the year, and location all effect the parturition process (Wiltbank et al., 1961). Everett and Magee (1965) reported weights of calves being influenced by seasonal and yearly variation. Berger (1994) noted fewer cows experience calving difficulty in spring and late summer months, with the highest incidence occurring in winter in the dairy industry. Burfening et al. (1987) reported calf birth weights and dystocia scores were lower in the southeastern United States than in other geographical regions of the nation. Furthermore, fetal weights and uterine blood flows were reduced (18% and 34%; respectively) when cows were heat stressed (Ferrell, 1993)

Review of literature notes factors, besides those previously outlined, that can contribute to dystocia. Vulval stenosis, uterine inertia and/or torsion, cervical and vaginal dilation failure, intrauterine post mortem fetal changes and premature delivery favor dystocia (Patterson, 1979).

Conclusions

Increases in the ratio of calf birth weight to dams weight results in an increased incident of dystocia. Bull calves are heavier than heifer calves, thus have a greater incidence of dystocia. Increases in gestation length also leads to an increase in birth weight. Sire breeds with larger mature size will have heaver birth weight and longer gestation lengths than sire breeds with smaller mature size.

Objectives of this research were to compare factors affecting dystocia of calves sired by calving ease Simmental and low birth weight Angus bulls. Birth weight, gestation length, calving ease score, and percent assisted births were measured to obtain sire breed comparisons.

CHAPTER 3

MATERIALS AND METHODS

Experimental Design

Research was conducted at four ranches, located at Judith Gap (1), Buffalo (2), Martinsdale (3), and Powderville (4), Montana during the years 1999 through 2001 (Table 1). Sire breed comparisons were made on calves (n = 1,039) sired by Simmental (n = 20) and Angus (n = 27) bulls out of 2-yr-old commercial Angus dams. Yearling heifers were bred each year to provide 2-yr-old dams the following spring.

Table 1. Records available for analysis per ranch per year.

	Ranch			
Year	1	2	3	4
2000	30	51	174	198
2001	69	57	216	244

The experiment was designed to use a large number of sires per breed group to best estimate breed group comparisons. Sires were selected based on EPDs to be of a calving ease type. Simmental were to be in the top 10% of the breed for calving ease EPD and Angus were to be in the top 10% of the breed for low birth weight EPD, and all sires were sampled from AI studs. Five sires were used both years and nine sires were used at more than one ranch (Table 2).

Students from Montana State University collected the calving data. Students received two training sessions prior to data collection in identification and treatment of dystocia. The speakers at the sessions were Bob Mortimer, DVM and Bob Bellows Ph D. Students observed heifers closely for calving difficulty by walking lots every 2 hours.

Heifers were allowed 2 hr of labor if partrition had not taken place with in 2 hr assistance was given. If abnormal presentation was observed then assistance was give imeaditly. Supervisors were present at data collection to help insure consistency in data collection.

Table 2. Sire overlap between year and ranch

	Year and ranch							
	2000				2001			
Sire	1	2	3	4	1	2	3	4
A				X		X		
B				X		X		
C	X		X				X	
D	X	X						
E	X	X						
F	X	X			X	X		
G		X						
H	X				X	X		
I	X	X						X
J		X	X	X				

X represent sire use

Management of Animals and Experimental Data

All animals were managed the same each year in a manner typical for the Northern Great Plains. However, ranch four shifted calving date 30d later in 2001 than in 2000. Heifers were allowed to graze native rang until early winter and were then supplemented to meet nutritional requirements. Heifers were held in feedlots under close observation 24 hr daily during the calving season (Jan. through April).

Signs of dystocia were recorded and assistance was give when necessary. Calving difficulty was given a numerical score (Bellows et al., 1971) based on the amount of assistance required. The scores of 1-5 were given describing the type of birth (1= no difficulty, 2= slight difficulty, some assistance required, 3= difficult birth, use of mechanical calf puller required, 4= extreme difficulty, including caesarean section, and

5= abnormal presentation). Scores from calves born as singles and not of malpresentation were analyzed. Shortly after birth, the calf was weighed and tagged, and the pair moved as soon as possible to another pen. Sex of calf, dam identification and date of birth were also recorded. Gestation length was calculated for all calves by subtracting date of calving from breeding date.

Statistical Analysis

The design is a randomized block with heifer as the experimental unit, sire breed the treatment and ranch as the block. The reason for blocking is to account for differences in management styles. Sire nested within sire breed is a random factor, as to not under estimate the standard errors of sire breed (Barkhouse et al., 1998). Differences in the number of calving records are due to incomplete calving records.

Calving records (n = 1032) were used to analyze birth weight. Birth weight was analyzed using the MIXED procedure of SAS (SAS Inst., Cary, NC). The dependent variable birth weight was analyzed with fixed effects of year, ranch, calf sex, sire breed, year x ranch, year x calf sex, year x sire breed, ranch x calf sex, ranch x sire breed, calf sex x sire breed, and the random effect of sire within sire breed. One interaction was found to be significant (year x ranch; $P < 0.05$) and all other were excluded from the final model. The final model used in the birth weight analysis included the fixed effects of ranch, calf sex, sire breed, year x ranch, and the random effect of sire within sire breed. Data is reported as contrasts of least square means ± SE.

Calving records (n = 1026) were used to analyze gestation length. Gestation length was analyzed using the MIXED procedure of SAS (SAS Inst., Cary, NC). The dependent variable gestation length was analyzed with fixed effects of year, ranch, calf sex, sire breed, year x ranch, year x calf sex, year x sire breed, ranch x calf sex, ranch x sire breed, calf sex x sire breed, and the random effect of sire within sire breed. All interactions were found not to be significant ($P > 0.05$) and were disregarded. The final model used in the gestation length analysis included the fixed effects of year, ranch, calf sex, sire breed, and the random effect of sire within sire breed. Data is reported as contrasts of least square means ± SE.

Calving records (n = 1,028) were used to analyze calving ease. Calving ease was analyzed using the MIXED procedure of SAS (SAS Inst., Cary, NC). The dependent variable calving ease was analyzed with fixed effects of year, ranch, calf sex, sire breed, year x ranch, year x calf sex, year x sire breed, ranch x calf sex, ranch x sire breed, calf sex x sire breed, year by calf sex by sire breed and the random effect of sire within sire breed. The year by calf sex by sire breed interaction was found to be significant ($P < 0.01$) and all other were excluded from the final model. The final model used in the calving ease analysis included the fixed effects of year by calf sex by sire breed and the random effect of sire within sire breed. Data is reported as contrasts of least square means ± SE.

Frequencies of assisted birth data, observed by ranch, were analyzed using the GLM procedures of SAS (SAS Inst., Cary, NC.). Effects of sire breed, calf sex, year, and calf sex by year where used in the model. The presence of calf sex by year interaction ($P < 0.01$) required calf sex to be analyzed within year.

CHAPTER 4

RESULTS AND DISCUSSION

Birth Weight

A total of 1,032 calves had complete birth weight records, and reflect calves born as singles and of normal presentation. Year did not affect ($P > 0.05$) calf birth weight. Sire breed ($P < 0.01$), calf sex ($P < 0.01$) and the ranch x year interaction ($P = 0.03$) affected calf birth weight (Table 3).

Table 3. Estimates (kg) of contrasts for birth weight model

Effect	Estimate	SE	*P* –Value
Sire breed[a]	2.13	0.37	< 0.01
Calf sex[b]	2.77	0.25	< 0.01
Ranch*year			0.03

[a] Simmental vs. Angus sires
[b] Bull vs. heifer calves

Simmental sired calves were 2.13 ± 0.37 kg heavier ($P < 0.01$) than Angus sired calves (Table 3). Laster et al. (1973) and Gregory et al., (1991) also found Simmental sired calves to have a greater birth weight than Angus sired calves; however, the difference (5.86 kg and 7.2 kg; respectively) was greater than that found in the current study. Furthermore, Nelson and Beavers (1982) observed about a 5 kg increase in birth weight for Charolais sired calves when compared to Angus sired calves. Part of the difference between the current and previous studies can be attributed to sire selection in the current study.

Bull calves were 2.77 ± 0.25 kg heavier ($P < 0.01$) than heifer calves. Previous research also notes bull claves being heavier than heifer calves (Burris and Blunn, 1952;

Franke et al., 1965; Nelson and Huber, 1971). The increased birth weight is likely a result of increased soft tissue, not skeletal size (Laster, 1974).

Due to ranch by year interactions ($P = 0.03$; Table 3) comparisons between ranches were examined within year (Table 4). Contrasts trend to decrease from year 2000 to 2001; however, ranch two increased. The variability represented by the effect of years in analyses of beef cattle data often represents more than the climatic and nutritional differences among years. Year effects include the influences of different sires and of changing cow herd (Olson et al., 1991). Note, that in the current study dam is confounded by year, because only calves from 2-yr-old dams were evaluated.

Table 4. Birth weight (kg) estimates of contrasts between ranches within year

	Year					
		2000			2001	
Ranch[a]	Estimate	SE	P–Value	Estimate	SE	P–Value
1 – 2	1.92	0.89	0.37	-1.37	0.72	0.56
1 – 3	2.15	0.77	0.10	1.17	0.76	0.78
1 – 4	2.71	0.59	< 0.01	1.33	0.54	0.21
2 – 3	0.22	0.91	1.00	2.54	0.77	0.02
2 – 4	0.79	0.89	0.99	2.70	0.69	< 0.01
3 – 4	0.56	0.75	1.00	0.16	0.73	1.00

[a] Ranch column represents contrasts between ranches as listed

Gestation Length

A total of 1,026 calves had complete gestation length records, and reflect calves born as singles and of normal presentation. Sire breed ($P < 0.01$), calf sex ($P < 0.01$), year ($P = 0.04$), and ranch ($P < 0.01$) affected gestation length (Table 5).

Gestation length of Simmental sired calves was 2.90 ± 0.48 d longer ($P < 0.01$) than Angus sired calves (Table 5). Smith et al. (1976) also found Simmental sired calves to have longer gestation lengths than Angus sired calves; however, the difference (4.6 d) was longer than that found in the current study. The study conducted by Smith et al. (1976) contained dams of various ages, two-yr-olds dams as were used exclusively in the current study. Therefore, part of the difference in gestation length between the current and previous studies may be attributed to sire selection and cow age.

Table 5. Estimates (d) of contrasts for gestation length

Effect	Estimate	SE	P –Value
Sire breed[a]	2.90	0.48	< 0.01
Calf sex[b]	1.30	0.27	< 0.01
Year of birth [c]	0.88	0.42	0.04

[a] Simmental vs. Angus sired calves
[b] Bull vs. heifer calves
[c] 2000 vs. 2001

Gestation lengths of bull calves were 1.30 ± 0.27 d longer ($P < 0.01$) than heifer calves, and is similar to the 1.9 days reported by Bellows et al. (1971), 1.2 days reported by Cundiff et al. (1974) and 1 day reported by Notter et al. (1978).

Gestation length in 2000 was 0.88 ± 0.42 days longer ($P = 0.04$) than 2001 (Table 5). This may be a result of a lower plane of nutrition in 2001 shorting gestation length (Kroker and Cummings, 1979), change in climate or cow herd (Olson et al., 1991).

The greatest observed gestation length difference between ranches was 2.82 ± 0.61 days ($P < 0.01$; Table 6). The differences between ranches likely due to cow herd differences (Olson et al., 1991) and/or a different plane of nutrition differences (Kroker and Cummings, 1979).

Table 6. Estimates of contrasts for gestation lengths (d) between ranches

Ranch[a]	Estimate	SE	*P* –Value
1 – 2	1.30	0.69	0.06
1 – 3	2.20	0.66	< 0.01
1 – 4	-0.62	0.50	0.22
2 – 3	0.90	0.62	0.15
2 – 4	-1.92	0.65	< 0.01
3 – 4	-2.82	0.61	< 0.01

[a] Ranch column represents contrasts between listed

Calving Ease

A total of 1,028 calves had complete calving ease records, and reflect calves born as singles and of normal presentation. Interactions of year by calf sex by sire breed ($P <$ 0.01) affect calving ease score. Ranch did not affect calving ease score ($P = 0.06$). Therefore, contrasts are presented as calf sex within sire breed within year (Table 7).

In 2000, Simmental bull calves (SB) had the highest ($P < 0.01$) calving ease score, followed by Angus bull calves (AB; $P < 0.01$), with no difference between Angus and Simmental heifer calves (AH, SH; Table 7). The greatest difference in calving ease scores was 0.70 and observed between SB and AH. The results supports previous research findings that bull calves have higher calving ease scores (Bellows et al., 1971; Brinks et al., 1973; Nelson and Beavers, 1982). Furthermore, Charolais sired calves .32 calving ease units greater than Angus sired calves (Nelson and Beavers, 1982).

In year 2001, SB had the highest ($P < 0.01$) calving ease score (Table 7). The AB were 0.16 ± 0.07 units higher ($P < 0.05$) than AH. However, as seen in 2000, no difference was detected between heifers of either breed. The greatest difference in calving ease scores was 0.37 and observed between SB and AH.

Table 7. Estimates of contrasts for sire breed by calf sex by year interaction[a]

	Sire breed by calf sex			
Sire breed by calf sex	AB	AH	SB	SH
2000				
AB	--	0.32[c]	-0.38[c]	0.29[c]
AH	--	--	-0.70[c]	-0.02
SB	--	--	--	0.68[c]
SH	--	--	--	--
2001				
AB	--	0.16[b]	-0.21[c]	0.04
AH	--	--	-0.37[c]	-0.13
SB	--	--	--	0.24[c]
SH	--	--	--	--

[a] P –value and SE (< 0.01, 0.09; respectively)
[b] $P < 0.05$
[c] $P < 0.01$

Assisted births

A total of 1,028 calves had complete percent assisted birth records, and reflect calves born as singles and of normal presentation. Main effects of sire breed, year and the interaction of calf sex by affected ($P < 0.01$) percent assisted births when observation is ranch (Table 8).

Table 8. Least-Squares Means ± SE for % assists

Main Effect	No. calves	% Assisted births
Sire breed	*	
Angus	579	28.62 ± 2.97
Simmental	449	41.29 ± 2.97
Year	*	
2000	442	42.32 ± 2.97
2001	586	27.59 ± 2.97
Sex of calf by year of birth	*	
Bull[a]	231	60.54 ± 4.20
Bull[b]	296	31.81 ± 4.20
Heifer[a]	211	24.10 ± 4.20
Heifer[b]	290	23.36 ± 4.20

[a] Year 2000
[b] Year 2001
* $P < 0.01$

Simmental sired calves required more assistance than Angus sired calves (41.29 and 28.62 ± 2.97 %, respectively). Smith et al. (1976) found Simmental sired calves to require 17 percentage units more assistance than Angus sired calves, which is greater than the current study (12.67 percentage units). However, the data analyzed in the study conducted by Smith et al. (1976) includes dams of ages 2-yr-old and older. Therefore, the difference between breeds is likely less than expected from only 2-yr-old dams.

Calves born in 2000 were assisted at a greater percent than in 2001 (42.32 and 27.59 ± 2.97 %, respectively). This may be a result of decreased birth weights between 2000 and 2001. Furthermore, year effects may include the influences of different sires and of a changing cow herd (Olson et al., 1991).

Bull calves were assisted more frequently than heifer calves, across both years; however, the difference between sexes was greater in 2000 than in 2001. These data are in agreement with previous studies where bull calves exhibited a higher frequency of dystocia than heifer calves (Young, 1968; Pattullo, 1973; Berger, 1994). Furthermore, Berger et al. (1992) found heifer calves to have 1.45 times greater chance to be delivered unassisted, than bull calves.

To compare the previously discussed variable of calving ease (Table 7) simple effects of sire breed by calf sex by year will be presented in Table 9.

CHAPTER 5

IMPLICATIONS

This experiment was conducted to compare factors affecting dystocia rates of calves sired by calving ease Simmental and low birth weight Angus bulls. Simmental sires with calving ease EPDs in the top ten percent of the breed can be mated to Angus heifers, of Montana origin, with only 10 to 15% increase in assistance over that of Angus sires selected to be in the top ten percent of the breed for low birth weight EPD. Furthermore, this mating may result in heavier weaning weights, yearling weights and greater rate of gain, which could be benefit commercial beef producers. Advancement of sexed semen technology will allow for the breeding of yearling replacement heifers to heifer semen, which should further decrease the incidence of dystocia.

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APPENDIX A

TABLES

Table 9. Contrasts for sire breed by calf sex by year[a] for assisted births

	Sire breed by calf sex			
Sire breed by calf sex	AB	AH	SB	SH
2000				
AB	--	25.26[c]	-18.82[b]	22.36[b]
AH	--	--	-44.08[c]	-2.90
SB	--	--	--	41.18[c]
SH	--	--	--	--
2001				
AB	--	14.94	-11.81	0.98
AH	--	--	-26.75[b]	-13.96
SB	--	--	--	12.78
SH	--	--	--	--

[a] P –value = 0.43
[b] $P < 0.05$
[c] $P < 0.01$

Table 10. Least-Squares Means ± SE (kg) for birth weight model

Effect	Estimate	SE
Sire breed		
Angus	33.35	0.28
Simmental	35.61	0.31
Calf sex		
Bulls	35.80	0.26
Heifers	33.03	0.26
Ranch by year		
1[a]	36.37	0.44
2[a]	34.44	0.80
3[a]	34.22	0.65
4[a]	33.66	0.40
1[b]	34.45	0.41
2[b]	35.82	0.59
3[b]	33.28	0.64
4[b]	33.12	0.35

[a] 2000
[b] 2001

Table 11. Least-Squares Means ± SE (d) for gestation length model

Effect	Estimate	SE
Sire breed		
Angus	279.10	0.35
Simmental	282.00	0.40
Calf sex		
Bulls	281.20	0.32
Heifers	279.90	0.32
Ranch		
1	281.27	0.39
2	279.97	0.59
3	279.07	0.56
4	281.89	0.33
Year		
2000	280.99	0.39
2001	280.11	0.33

Table 12. Least-Squares Means ± SE for calving ease model on a 1-4 scale

Effect	Estimate	SE
Sire breed by sex		
AB[a]	1.57	0.05
AH[a]	1.26	0.05
SB[a]	1.97	0.07
SH[a]	1.28	0.07
AB[b]	1.32	0.05
AH[b]	1.16	0.05
SB[b]	1.52	0.05
SH[b]	1.28	0.05

Sire by sex abbreviations are: Angus bulls (AB), Angus heifers (AH), Simmental bulls (SB), and Simmental heifers (SH)

[a] 2000

[b] 2001