ECONOMIC COMPARISON OF
ANGUS, RED ANGUS, AND ABERDEEN-
INFLUENCED
COW-CALF PRODUCTION

By

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Title of Study: ECONOMIC COMPARISON OF ANGUS, RED ANGUS, AND ABERDEEN-INFLUENCED COW-CALF PRODUCTION

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Abstract: This research investigates the differences in cow-calf profitability between Angus-, Red Angus-, and Aberdeen-Influenced herds. Differences in revenue by dam and sire breed were estimated using birth weight, calving interval, and weaning weight simulations for a ten-year period. Pasture, hay, and protein supplementation expenses were estimated by breed. Returns to overhead by dam and sire breed were computed, resulting in nine sire by dam breed returns for ten years. Overall, the highest returns in dollars per head per acre were found with Angus dams bred to Angus bulls. However, the difference in returns between dam breeds for a given sire breed are not likely statistically significant.

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CHAPTER I

INTRODUCTION

Many factors determine the profitability of U.S. cow-calf production. According to Miller et al. (2001), the annual cost of maintaining a beef cow, calf sale price, and calf weaning weight are the most influential factors that determine a cow-calf operation's profit. As production costs and weaning weights are influenced by breed, both cow and sire breeds likely significantly affect these profit-influencing factors. For example, Mitchell et al. (2009) found that leptin genotype influenced weaning weight and longevity in some breeds but was insignificant in other breeds. These differences translated into differences in cow herd profitability for some breeds (Mitchell et al.).

Of interest in this study are how differences in birth weights, calving interval, weaning weights, and feed expenses vary across Angus-, Red Angus-, and American Aberdeen-influenced cow herds and how those differences translate into profits. It is believed that this is the first study to investigate an Aberdeen-influenced herd in comparison to closely related breeds. All three of these breeds derive from the same lineage but have developed under different selection pressures. According to Angus Association (2020), in 1873, four Angus bulls were transported from Scotland to Kansas. Over the next decade, 1,200 Angus cattle were imported to the Midwest, eventually becoming the American Angus breed (Angus Association 2020). This breed was known for its polled heads and solid black bodies whose genetics, when crossed with the native longhorn cows, produced hornless black calves who thrived on winter range and gained better in the spring (Angus Association 2020).

The Red Angus breed has the same origin as Angus, but have red pigmentation due to a recessive gene (Oklahoma State 2015). In 1954, the Red Angus Association of America was established (Oklahoma State 2015).

The origins of the Aberdeen breed date to 1974. An Angus herd at the Trangie (Australia) Research Center was separated into a “Lowline” herd, who had low yearling growth rates, and a “Highline” herd, who had high yearling growth rates (American Aberdeen 2020). After fifteen years researching the two herds, the “Lowline” herd stabilized to being 30% smaller than the “Highline” herd (American Aberdeen 2020). “Lowline” cattle were imported and became the American Aberdeen cattle breed. Aberdeen cows are known for their calving ease, docility, decreased feed requirements, and higher stocking rates (American Aberdeen 2020).

While these three breeds have a common origin, selection pressures have changed genetics and phenotypes, including weight. This is relevant as mature beef cow weight has steadily increased in U.S. herds (Wiseman et al. 2018), leading to increased weaning weights. However, Bir et al. (2018) found the marginal gains from heavier weaned calves are offset by increased feed costs, resulting in lighter cows stocked at heavier rates having higher economic returns. Since the Aberdeen breed was selected for lighter weights, the results from Bir et al. suggest potential for improved cow-calf profits over their related Angus and Red Angus cousins.

Calving interval also affects cow-calf profitability. A narrow calving window translates into more uniform calves and larger lot sizes at auction, potentially increasing returns. Ward et al. (2017) found that marketing calves in uniform lots of ten head or more receive higher premiums than smaller non-uniform lots, indicating buyers prefer larger sale lots and are more willing to pay higher prices for them. Comparing a lot selling one calf and a lot selling 10 calves, there is a $7.00 premium on the larger lot. If there are differences in calving interval between breeds, this could lead to differences in economic returns. There are two effects that calving interval has, mean and variability. Longer average calving interval means younger calves at weaning and lower value. Higher variance of calving interval means less uniformity, smaller lot sizes, and lower value.

Amundson (2020) found that operations can economically benefit by practicing management strategies that tighten calving intervals. A cow herd is more profitable with tight calving intervals as tight calving intervals lead to more uniform groups of calves that better meet the demand of the beef market (Howard 2013). Brown et al. (1954) define calving interval as the time elapsing from the date of birth of a cow's calf until the birthdate of her next calf. Brown et al. (1954) concluded that calving intervals are influenced by calf's sire, cow nutrition, cow age, and the birth weight of the cow's previous calf. Titterington et al. (2017) also reported breed of dam, age of dam, and month of calving significantly affected calving interval.

Ideally, a cow will produce one calf each year after being bred during the breeding window, to ensure she will calve the same time each year. In doing so, producers will synchronize their herds so that each cow calves during the same interval each year. If a cow does not rebreed in the allotted time, the producer must decide whether to transition her to a later breeding season, cull her, or retain her with delayed calving (Carpenter 2020). Moving a cow to a later calving season may select for poor fertility characteristics compared to those who calve in the preferred interval, but culling a cow before producing enough calves to breakeven reduces the net worth of the enterprise.

Given the results of Brown et al. (1954), it is possible that genetic and phenotypical differences between Angus, Red Angus, and Aberdeen breeds differentially influence calving interval. However, prior research has not considered potential differences between the Angus and Angus-derived cattle.

The three beef breeds evaluated here have similar lineage but, due to differences in selection pressures, may have characteristics that lead to differences in economic returns. Specifically, hypothesized differences in calving interval and weaning weights and associated production costs potentially lead to differences in cow herd profitability.

Objectives

The goal of this study is to estimate the differences in cow-calf profitability between Angus, Red Angus, and Aberdeen herds.

Specific objectives are:

1. Determine differences in calving weights, calving intervals, and calf weaning weights for a herd of Angus, Red Angus, and Aberdeen cows.
2. Determine difference in feed costs for cows by breed in the herd.
3. Determine the difference in cow-herd profitability due to cow and sire breeds.

Methodology

Regression models were developed to estimate calf birth weights, calving intervals, and calf weaning weights as functions of dam and sire breeds, dam's weight, age, year of birth, and calf sex. These models allow for a comparison between Angus, Red Angus, and Aberdeen breeds. Rations were developed for each cow herd using the CowCulator program (Lalman, 2010). Monthly rations were developed based on the age of the cow, stage of gestation, and breed. Using the regression models, calf weaning weights were simulated, and prices assigned using historical data. Cow, sire, and calf data were taken from North Dakota State University's Dickenson Research Extension Center (DREC). Calf prices were taken from Oklahoma's combined auctions (Livestock Marketing Information Center, 2020) weighted average summary for heifer and steers for years 2010-2019, and interpolated by dam age. These prices were used to calculate revenue using Bir et al. (2018) probabilities of dams staying in the herd by age. Estimated feed requirements were calculated using Bir et al. (2018) research. Sedivec et al. (2020) native hay utilization rate of 80% and 1,800 pound yield, and Meehan et al. (2018) 25% native grazing utilization rate were used to calculate feed requirements per animal. A $20 per acre native pasture lease price and a $66 per ton native hay price from North Dakota were found using USDA's National Agriculture Statistics Service Quick Tool for 2019 (USDA 2019). 20% Range and Breeder Cube prices were taken from Stillwater Milling Company (2020).

Outline of study

For the remainder of the research, the study is organized as follows. Chapter two reviews past literature, specifically looking into what influences calf birth weight, calf weaning weight, and calving intervals. Chapter three reviews the methodology behind the study and includes bio-economic and empirical models. Chapter four reviews the results of the study. Chapter five includes conclusion, implications, and study limitations for the research.

CHAPTER II

LITERATURE REVIEW

Calving interval is potentially influenced by several factors. Titterington et al. (2017) observed the breed of dam, age of dam, and month of calving significantly influenced calving interval. Frazier et al. (1999) found birth weight, sex, and weaning weight predict calving interval. An increase in birth weight resulted in longer mature calving intervals, and mature calving intervals decreased as weaning weight increased.

Titterington et al. (2017) experiment found a mean calving interval of 395 days, with Angus dams having the shortest calving interval (392 days). Charolais and Belgian Blue dams had the longest calving intervals, 399 and 400 days, respectively. Sire breed at partition one was significantly associated with calving interval. Charolais and Angus sires had the shortest calving intervals. In partition 2, Simmental, Hereford, and Angus sires had the shortest calving intervals. Flores (1971) found a significant effect on fertility variability based on breed, but no explanation was offered to explain this variability.

According to Frazier et al. (1999), higher birth weight resulted in longer mature calving intervals, and mature calving intervals decreased as weaning weight increased. Birth weight and weaning weight predicted calving interval but were affected by changes in growth traits (Frazier et al. 1999).

Doren et al. (1986 pg. 1194) found “weaning weight of the previous calf was positively correlated with postpartum conception and calving interval.” However, an adjustment for differences in breed type and environmental factors were needed to observe the magnitude of the relationship. MacGregor et al. (2000) recommended calving date and actual weaning weight of calves to be considered when evaluating the reproductive and productive performance of breeding cows as their research found that early-calving dams produced lower birth weight calves with highest weaning weights and pre-breeding heifer weights. “A one-day increase in calving interval resulted in a decrease of 0.29±0.01 kg for weaning weight and a decrease of 0.54±0.01 kg for heifer pre-breeding weight” (MacGregor et al. pg. 70).

Flores (1971) compared the reproductive performance of beef and dairy cattle under similar conditions. Flores’s (1971) purpose was to compare fertility between breeds. Flores (1971) compared breeding efficiency differences between cows, which have calved once, twice or three times over a three-year period. Sire breed significantly affected fertility. Flores (1971) also concluded birth weight of a calf was a significant factor in determining gestational length.

CHAPTER III

METHODOLOGY

Bio-economic Model

It is assumed that the producer's objective is to maximize weighted-average returns to fixed costs, labor, and management from cow-calf production by choosing sire and dam breeds. Mathematically,

(1)

$$\begin{aligned}\underset{D,S}{Max}\sum_{m=1}^{10}[E[(Weaning\,Weight(D,S,Age\,at\,weaning(CI,D,S)]\times E[Price(Weaning\,Weight_m)]\\ -E[Cost(Cow\,weight_m,age_m,D)])\times f(m)]/\,Acres\;per\;head\end{aligned}$$

where D and S are dam and sire breeds, respectively, m is the age of the cow, and $f(m)$ is the age distribution of the cow herd. Since there was a fixed resource for grazing land, returns per acre were used instead of returns per head.

To calculate expected profits, expected weaning weights were estimated for Angus (AN), Red Angus (AR), and Aberdeen (LO) beef cows and bulls. Weaning weights were estimated functions of birth weights and calf age at weaning (among other variables), similar to Bir et al. (2018). Given the potential for calving interval to differ between sire and dam breeds, calving interval was also estimated and used to calculate calf weaning age on October 31st, the assumed weaning date

Empirical Models

Calf Birth Weight model

A calf birth weight model, modified from Bir et al. (2018), was used to estimate birth weight as a function of dam and sire breeds, dam's weight, age, and age squared, year of birth, and calf sex. This model was estimated using SAS MIXED procedure (SAS Institute Inc., 2012). The model was specified as

(2)

$$
\begin{aligned}
&CalfBirthWeight_{it} = \alpha_1 + \alpha_2 ADG_{i,t-1} + \alpha_3 CowBCSatWean_{i,t-1} + \alpha_4 CowWeightAtWean_{i,t-1} \\
&+\alpha_5 CowAge_{it} + \alpha_6 CowAge_{it}^2 + \alpha_7 AR_{it} + \alpha_8 LO_{it} + \alpha_9 C\_AR_{it} + \alpha_{10} C\_LO_{it} + \alpha_{11} C\_Unkwn \\
&+\alpha_{12} C\_UK_{it} + \alpha_{13} C\_Cont_{it} + \alpha_{14} CalfBirthYear_{it} + \alpha_{15} CalfSex_{it} + e_{it} + v_t
\end{aligned}
$$

where $CalfBirthWeight_{it}$ denotes calf birth weight for animal *i* and year *t*, α_1 denotes the intercept for an Angus sire and Angus dam. $ADG_{(t-1)}$ denotes the dam's average daily gain from her previous calving. $CowBCSatWean_{(t-1)}$ denotes the dam's body condition score at her previous weaning. $CowWeightAtWean_{(t-1)}$ denotes the dam's weight at her previous weaning. $CowAge_{it}$ denotes the age of the dam and was estimated in quadratic form. AR_{it} denotes a Red Angus sire and LO_{it} is an Aberdeen sire. C_AR_{it} denotes a Red Angus dam, C_LO_{it} is an Aberdeen dam, C_UNKWN_{it} are the dams of unknown breeds, C_UK_{it} are dam breeds from the UK (other than AN, AR, and LO), and C_CONT_{it} are Continental dam breeds. $CalfBdateYear_{it}$ is the year that the calf was born. $CalfSex_{it}$ indicates calf sex ε\{Heifer, Bull\}. The error term e_{it} and a random effect for year v_t are assumed to be independent and normally distributed for animal i and year *t*.

Calving Interval Model

Calving interval was estimated using SAS Proc MIXED (SAS Institute Inc., 2012) and specified as:

(3)

$$LnCalvingInterval_{it} = \beta_1 + \beta_2 BirthWeightRatio_{i,t-1} + \beta_3 ADG_{i,t-1} + \beta_4 CowBCSatWean_{i,t-1} + \beta_5 CowWeightAtWean_{i,t-1}$$
$$+ \beta_6 CowAge_{it} + \beta_7 CowAge_{it}^2 + \beta_8 AR_{it} + \beta_9 LO_{it} + \beta_{10} C\_AR_{it} + \beta_{11} C\_LO_{it} + \beta_{12} C\_Unkwn$$
$$+ \beta_{13} C\_UK_{it} + \beta_{14} C\_Cont_{it} + \beta_{15} CalfBirthYear_{it} + \beta_{16} CalfSex_{it} + \varphi_{it} + r_t$$

where $LnCalvingInterval_{it}$ denotes the natural log of the number of days between each calf a dam calves for animal *i* and year *t.* β_1 denotes the intercept for an Angus sire and Angus dam. $BirthWeightRatio_{(t-1)}$ is lagged birth weight divided by dam weight at weaning from the previous year. The error term φ_{it} and a random effect for year r_t are assumed to be independent and normally distributed.

Weaning Weight Model

A calf weaning weight model from Bir et al. (2018) was used to estimate weaning weight as a function of calf's birth weight, age at weaning, dam and sire breeds, dam's weight, age, age squared, year of birth, and calf sex. This model was estimated using SAS Proc MIXED (SAS Institute Inc., 2012). The model was specified as:

(4)

$$
\begin{aligned}
CalfWeaningWeight_{it} &= \delta_1 + \delta_2 AR_{it} + \delta_3 LO_{it} + \delta_4 CalfBirthWeight_{it} + \delta_5 AgeAtWean_{it} \\
&+ \delta_6 CowBCSatWean_{i,t-1} + \delta_7 CowWeightAtWean_{i,t-1} + \delta_8 CowAge_{it} + \delta_9 CowAge_{it}^2 + \\
&+ \delta_{10} C\_AR_{it} + \delta_{11} C\_LO_{it} + \delta_{12} C\_Unkwn_{it} + \delta_{13} C\_UK_{it} + \delta_{14} C\_Cont_{it} \\
&+ \delta_{15} CalfBirthYear_{it} + \delta_{16} CalfSex_{it} + u_{it} + w_t
\end{aligned}
$$

where $CalfWeaningWeight_{it}$ denotes calf weaning weight for animal *i* and year *t*, δ_1 denotes the intercept for an Angus sire and Angus dam. The error term u_{it} and a random effect for year w_t are assumed to be independent and normally distributed.

Dam Weight at Weaning Model

For each breed, dam weight from age two through ten was needed to simulate calf birth weight, calving interval, and calf weaning weight. Dam weight at weaning by breed from equation (5) was estimated using Proc Mixed in SAS using data from Dickenson Research Extension Center (DREC):

(5)

$$
DamWeightAtWean_{it} = \theta_1 + \sum_{n=2}^{4} \theta_i DamBreed_{it} + \theta_5 DamAge_{it} + \theta_6 DamAge_{it}^2 + s_{it}.
$$

Simulated Returns

In order to determine maximum revenue by dam and sire breed, birth weight, calving interval, and weaning weight models were simulated using equations (2)-(5). Nine combinations of dam and sire breeds were included in the simulations. First, bull and heifer birth weights were simulated using the regression results from equation (2). Variables were held at mean values by dam and sire breeds. Next, using the deterministically simulated birth weights and estimated coefficients from equation (3), calving intervals were simulated. Lastly, simulated birth weights and calving intervals and estimated coefficients from equation (4) were used to simulate weaning weights by dam and sire breeds for steer and heifer calves. These results, along with the calf price data pulled from Oklahoma's combined auction prices (Livestock Marketing Information Center, 2020) (Table 1), were used to calculate heifer and steer revenues by year, cow age, dam breed, and sire breed. The number of heifers sold was adjusted down to account for heifers retained as replacements for culled cows.

An age distribution of cows, taken from Azzam et al. (1990) as modified by Bir et al. (2018), was assumed to generate the distribution of calf weaning weights and revenues based on dam age. Based on the culling model, just over 19 heifers were retained for a 100-head breeding herd. The model assumed 85% of the retained heifers breed with the balance culled as feeder heifers.

A 92.8% calving percentage was used for cow ages 3 to 10, to distinguish the number of calves weaned divided by the number of cows exposed to a bull (Ringwall, 2020). For two year old heifers, a 98% calving percentage was assumed.

Table 1. Calf Prices from Oklahoma's Combined Auctions ($/cwt)

	Weight in pounds:	350	450	550	650	750
	Steer	127.79	122.6	114.09	111.49	112.14
2010	Heifer	111.51	109.12	104.93	105.25	104.21
	Steer	148.33	141.68	137.30	141.63	139.72
2011	Heifer	130.42	127.00	127.00	130.62	129.02
	Steer	192.98	169.39	154.49	146.11	144.24
2012	Heifer	164.87	146.70	136.60	137.82	132.65
	Steer	205.62	186.05	167.13	167.08	162.41
2013	Heifer	175.46	162.00	154.00	153.09	147.72
	Steer	350.86	295.13	263.52	249.41	241.90
2014	Heifer	298.02	263.35	239.71	234.46	223.85
	Steer	237.57	226.15	200.49	193.44	184.34
2015	Heifer	213.02	191.22	179.67	180.15	174.32
	Steer	155.14	140.76	128.22	120.31	128.87
2016	Heifer	132.43	123.56	116.97	124.40	121.50
	Steer	191.85	173.31	157.95	154.57	152.44
2017	Heifer	158.66	150.67	141.85	146.38	142.60
	Steer	183.18	171.11	161.09	157.44	155.57
2018	Heifer	152.03	145.65	144.65	149.82	148.59
	Steer	174.25	162.10	150.9	147.56	147.45
2019	Heifer	146.88	139.93	135.24	137.76	133.37

Data

Data on cows, bulls, calves, and calving season were collected from North Dakota State University's Dickenson Research Extension Center (DREC) research herd. In the 1990's, DREC started discussing the benefits of small cows versus large cows and began breeding larger heifers to several breeds, including Angus, Red Angus, and Aberdeen bulls. DREC's research focused on comparing breed efficiency. Data were collected from 2001 to 2018 and consisted of 2,104 observations. Data included dam breed, dam birth date, sire breed, calf birth date, calf sex, calf birth weight, calf weaning date, calf weaning weight, dam weight at weaning, and dam body condition score. Summary statistics for the data are shown in Table 2.

Feeder calf and cull cow prices from Oklahoma City (LMIC 2020) and the age distribution model were used to calculate weaned calf, cull feeder heifer, and cull cow revenues. Pasture, hay, and protein supplementation requirements were calculated using CowCulator (Lalman, 2010). Given the climate in western North Dakota, cows were assumed to graze for seven months and fed hay for the remaining five months each year. Protein in the form of 20% range cubes was used to supplement protein as required. Rations were computed for each breed by cow age and month of the year, resulting in 360 rations. Annual requirements for pasture, hay, and protein were computed by summing across months by age and breed.

Using a yield of 1,800 pounds per acre for crested wheat grass (Sedivic et al. 2020) and a pasture utilization rate of 25% (Meehan et al. 2020), acres of pasture were computed for each breed and cow age by month. These acreage requirements were then multiplied by the age distribution model to generate a weighted-average acreage requirement by dam breed, i.e., acres of pasture per cow.

Hay was assumed to be fed October through March with an 80% utilization rate. Dividing the annual hay requirement by 0.8 generated annual hay purchases by breed and age. Then, the distributions of hay purchases were weighted by the age distribution and summed to generate the weighted-average hay purchased, i.e., pounds of hay fed per cow. Pounds of protein (20% range cubes) fed were similarly computed, assuming a 100% utilization rate. USDA National Agriculture Statistics data were used for North Dakota pasture lease rates and hay prices (USDA, 2019). Protein (20% range cube) prices were taken from Stillwater Milling Company (2020).

Table 2. Summary Statistics (n=1204)

Item	Mean	SD	Minimum	Maximum
Calf Birth Weight	76.9	6.3	25.0	140.0
Lagged Calving Interval	370.6	0.09	309.0	784.0
Calf Weaning Weight	499.6	42.1	170.0	776.0
Calf Age at Weaning in Days	205	23.89	127	253
Lagged Calf Birth Weight Divided by Cow's Weight at Weaning	0.06	0.02	0.02	0.7
Lagged Average Daily Gain	1.0	0.08	0.5	1.6
Lagged Cow Body Condition Score at Weaning	5.5	1.1	0	8.0
Lagged Cow weight at Weaning	1236.6	96.5	704.0	1920.0
Dam Weight at Weaning	1236.6	96.5	704.0	1920.0
Dam Age at Weaning	4.6	2.2	2.0	14.0
Cow Age at Calving Years	3.8	2.1	1.0	13.2
Cow Age at Calving Squared Years	18.9	22.9	1.0	173.4
Angus Sire (n)	187	--	--	--
Red Angus Sire (n)	655	--	--	--
Aberdeen Sire (n)	362	--	--	--
Angus Dam (n)	166	--	--	--
Red Angus Dam (n)	341	--	--	--
Aberdeen Dam (n)	277	--	--	--
Unknown Dam (n)	271	--	--	--
UK Dam (n)	20	--	--	--
Continental Dam (n)	129	--	--	--
Calf Birth Year (n)	--	--	2003	2018
Calf Sex (Heifer) (n)	634	--	--	--
Calf Sex (Bull) (n)	570	--	--	--

CHAPTER IV

RESULTS

Regression results

Birth Weight Model Results

The coefficient estimates, standard errors, and level of significance for the calf birth weight model are shown in Table 3. Of the 14 variables, seven coefficient is significant at p≤0.05, six coefficient is significant at the p≤0.01, and five coefficients are statistically significant at p≤0.0001.

The intercept is positive and statistically significant. The coefficient for cow weight at previous weaning ($CowWeightAtWean_{(t-1)}$) is positive and statistically significant. Cows that are in good condition birth heavier calves. The coefficient for cow age ($AgeAtCalving$) is positive and statistically significant, increasing calf's birth weight by 8.2 pounds. The coefficient for cow age squared ($CowAge^2$) is negative and statistically significant. Of the sire breeds, only the Aberdeen coefficient (LO) was statistically significant, decreasing birth weight by 5.7 pounds relative to Angus sires. The Aberdeen dam coefficient (C_LO) is negative and statistically significant, decreasing birth weight by 8.7 pounds, relative to Angus dams. The sex of the calf coefficient

($CalfSex$) is a dummy variable with a base of a bull calf. The coefficient is negative and statistically significant, indicating heifer birth weights are 6.4 pounds lighter than bulls.

Calving Interval Model Results

The coefficient estimates for the natural logarithm of calving interval ($LnCalvingInterval$) model are also shown in Table 3. Of the 15 variables, three are significant of at the $p \leq 0.05$, while one coefficient is significant at $p \leq 0.0001$.

The coefficient for calf's birth weight divided by cow's weight at weaning of previous calf ($BirthWeightRatio_{(t-1)}$) is positive and significant at the $p \leq 0.05$ level. Heavy calves relative to dam weight increase the follow calving interval. This may be due to increased nutritional demands during pregnancy delaying breeding and due to increased damage to the reproductive tract during calving. Average daily gain of the previous calf ($ADG_{(t-1)}$) is negative and significant at the $p \leq 0.05$ level. This may be due to higher metabolic efficiency of the dam leading to both higher ADG of her calves and shorter calving interval. Alternatively, it could be driven by weather. Better environmental conditions post-partum lead to higher ADG for calves and shorter calving intervals.

Calf Weaning Weight Model Results

The coefficient estimates for the calf weaning weight model ($CalfWeaningWeight$) are shown in Table 3. Of the 15 variables, 11 are significant at $p \leq 0.05$ or smaller, with 10 coefficients statistically significant at $p \leq 0.0001$.

The intercept coefficient ($CalfWeaningWeight$) is negative and statistically significant. The coefficient for calf birth weight ($CalfBirthWeigh$t) is positive and statistically significant. Heavier calves at birth are heavier at weaning. The coefficient for cow body condition score (BCS) at the previous calf weaning ($CowBCSatWean_{(t-1)}$) is negative and statistically significant. This result is counter intuitive but may be related to lower milk production. Cows producing less milk may be better able to maintain BCS but wean lighter calves. The coefficient for cow weight at weaning ($CowWeightAtWean$) is positive and statistically significant. Bigger cows wean heavier calves. The coefficient for cow age ($AgeAtCalving$) is positive and statistically significant, increasing calf's weaning weight by 31.2 pounds. The coefficient for cow age squared ($CowAge^2$) is negative and statistically significant. Of the two sire breeds, only the Aberdeen sire coefficient (LO) was statistically significant. Aberdeen-sired calves were 26.9 pounds lighter, on average, than Angus-sired calves. Calf sex coefficient ($CalfSex$) is negative and statistically significant, indicating heifer weaning weight was 28.2 pounds lighter than bull (or steer) weaning weight.

Table 3. Mixed Procedure Results for Birth Weight, Natural Log Calving Interval, and Weaning Weight

Variable*	Birth Weight (SE)	Ln Calving Interval (SE)	Weaning Weight (SE)
Intercept	64.4**** (1.92)	5.9**** (0.04)	-229.1**** (13.21)
Calf Birth Weight	-	-	4.8**** (0.13)
Calf Age at Weaning			1.2**** (0.04)
Lagged Calf Birth Weight Divided by Cow's Weight at Weaning*****	-	0.7** (0.26)	-
Lagged Average Daily Gain*****	-1.3 (2.26)	-0.09** (0.04)	-
Lagged Cow Body Condition Score at Weaning	-0.3 (0.15)	0.002 (2.46e-3)	-6.7**** (0.72)
Lagged Cow weight at Weaning	0.02**** (2.0e-3)	4.8e-5 (3.9e-5)	0.2**** (1.06e-2)
Cow Age at Calving Years	3.7**** (0.37)	-8.5e-3 (5.52e-3)	14.2**** (1.63)
Cow Age at Calving Years Squared	-0.3**** (0.03)	6.3e-4 (6.33e-4)	-1.1**** (0.13)
Red Angus Sire	1.4 (0.87)	-1.9e-4 (9.75e-3)	-22.3*** (3.50)

Aberdeen Sire	-5.7** (1.05)	-0.01 (0.01)	-63.9**** (4.20)
Red Angus Dam	-0.3 (0.33)	6.9e-3 (5.07e-3)	5.3 (1.36)
Aberdeen Dam	-8.7 (0.35)	6.1e-1 (5.73e-3)	-26.9**** (1.74)
Unknown Dam	-0.5 (0.48)	-1.7e-3 (7.78e-3)	-1.9 (1.99)
UK Dam	-0.6 (0.31)	-1.5e-3 (5.04e-3)	-0.4 (1.31)
Continental Dam	2.5*** (0.43)	5.8e-3 (7.13e-3)	2.1 (1.79)
Calf Sex (Heifer)	-6.4**** (0.28)	-4.9e-3 (4.52e-3)	-28.2**** (1.23)

*Fixed effects by year omitted for brevity.
**P≤0.05; ***P≤0.01; ****P≤0.001.
*****In the Birth Weight model and Calving Interval model, it is possible that Cow BCS and Cow Weight at Weaning are influenced by breed but this investigation is beyond the scope of the study.

Dam Weight at Weaning

Table 4 provides the Proc Mixed regression results for dam weight at weaning (equation 5) by breed and age. Coefficients for cattle breeds were negative and statistically significant when compared to the base dam breed, Simmental. The coefficient for dam age was positive and statistically significant, while the coefficient for dam age squared was negative and statistically significant. This implies that dam weight at weaning increases up to about age 10 and then declines. Most cows are culled at or before 10 years of age. These results were used to simulate Angus-, Red Angus-, and Aberdeen- influenced dam weights at weaning by age, provided in Table 5. On average, Angus dams weigh 92 pounds more than Red Angus Dams and 311 pounds more than Aberdeen dams at weaning.

Table 4. Regression Results for Dam Weight at Weaning by Breed and Age

Variable*	Estimate
Intercept	1079.8*** (12.3)
Angus	-135.1*** (9.5)
Red Angus	-226.7*** (8.7)
Aberdeen	-446.5*** (8.9)
Age	123.5*** (3.8)
Age Squared	-6.3*** (0.3)

*Other breeds omitted for brevity.

**P≤0.05; ***P≤0.01; ****P≤0.001.

Table 5. Simulated Angus, Red Angus, and Aberdeen-Influenced Dam Weights at Weaning by Age

Age	Angus	Red Angus	Aberdeen
3	1259	1167	947
4	1339	1247	1027
5	1406	1314	1094
6	1460	1369	1149
7	1503	1411	1191
8	1532	1440	1221
9	1549	1458	1238
10	1554	1462	1242

Simulated Calf Birth Weights

Using the regression estimates from equation 2, expected birth weight values were simulated. Variables were held at mean values except for sire and dam breeds, which were varied across the three breeds. Table 6 reports the simulated birth weights by dam and sire breed and age of dam As expected, younger cows birth lighter calves, Calf birth weights peak at age 6. As expected, heifer birth weights are 5-7 pounds lighter than bull calf weights. For both calf sexes, there is only a 1-2 pound birth weight difference between an Angus or Red Angus sire on Angus and Red Angus dams. Aberdeen sires with Angus and Red Angus dams result in 5-6 pound lighter calf birth weights compared to Angus and Red Angus sires. For an Angus dam and Angus sire, bull calf birth weights range by dam age from 90 to 102 pounds, and heifer birthweights range from 84 to 95 pounds. For a Red Angus dam and Red Angus sire, bull calf birthweights range by dam age from 91 to 102 pounds, and heifer birth weights range from 84 to 95 pounds. For an Aberdeen dam and Aberdeen sire, bull calf birth weights range by dam age from 73 to 84 pounds, and heifer birthweights range from 67 to 78 pounds. There is a 16.18 pound increase in birth weight for Angus and Red Angus breeds compared to Aberdeen.

Table 6. Simulated Bull and Heifer Calf Birth Weight (lb)

Dam:		-----------AN*-----------			-------------AR------------			-----------LO----------		
Sire:		AN	AR	LO	AN	AR	LO	AN	AR	LO
Cow Age	Calf Sex									
	Bull	90	89	79	92	91	80	85	83	73
2	Heifer	84	83	72	85	84	74	80	77	67
	Bull	95	94	84	97	95	85	89	88	78
3	Heifer	89	88	77	90	89	79	84	82	71
	Bull	99	97	87	100	99	88	93	92	81
4	Heifer	92	91	81	94	92	82	88	85	75
	Bull	101	101	89	102	101	91	95	94	83
5	Heifer	94	93	83	96	95	84	90	87	77
	Bull	102	100	90	103	102	91	96	95	84
6	Heifer	95	94	84	97	95	85	91	88	78
	Bull	101	100	89	102	101	91	95	94	84
7	Heifer	95	94	83	96	95	84	90	88	77
	Bull	99	98	87	101	99	89	93	92	81
8	Heifer	93	92	81	94	93	82	88	86	75
	Bull	96	95	84	97	96	86	90	89	79
9	Heifer	90	88	78	91	90	79	85	83	72
	Bull	92	90	80	93	92	81	86	85	74
10	Heifer	85	84	74	87	85	75	81	78	68

*AN=Angus; AR=Red Angus; LO=Aberdeen.

Simulated Dam Calving Intervals

Using the regression estimates for equation 3, calving intervals were simulated for each dam breed × sire breed for cow ages three through ten. Table 7 reports simulated calving interval for steer and heifers by dam and sire breed. Variables were held at mean values. Little difference was observed in calving intervals by dam and sire breed. Between ages 3 and 10, calving interval varied by 1-2 days. Comparing calf sexes, dams who calve heifers have 1-4 days shorter calving intervals than if she calves more bull calves. This is due to heifer calves weighing less at birth. So, dams recover and cycle faster. An Aberdeen dam bred to an Aberdeen bull had a calving interval that was 3-7 days shorter than Angus dams sired by Angus bulls and Red Angus dams sired by Red Angus bulls.

Table 7. Simulated Calving Interval (days)

Dam:		-----------AN*-----------			-------------AR------------			-----------LO----------		
Sire:		AN	AR	LO	AN	AR	LO	AN	AR	LO
Cow Age	Calf Sex									
	Bull	367	370	369	367	370	370	362	364	364
3	Heifer	365	368	368	366	369	368	361	363	362
	Bull	367	370	369	367	370	370	362	365	364
4	Heifer	366	369	368	366	369	367	361	364	363
	Bull	368	370	370	368	371	370	363	365	364
5	Heifer	366	369	368	367	369	367	362	364	363
	Bull	368	370	370	368	371	370	363	365	364
6	Heifer	367	369	368	367	369	367	362	364	363
	Bull	368	370	369	368	371	370	363	365	364
7	Heifer	367	369	368	367	369	366	362	364	363
	Bull	368	370	369	368	370	370	363	365	364
8	Heifer	366	369	368	367	369	366	362	364	363
	Bull	367	370	368	367	370	369	362	365	363
9	Heifer	366	369	367	366	369	365	361	364	362
	Bull	367	369	368	367	369	368	362	364	363
10	Heifer	366	368	367	366	368	364	361	363	362

*AN=Angus; AR=Red Angus; LO=Aberdeen.

Simulated Calf Weaning Weights

Using the regression estimates from equation 4, weaning weights were simulated. Table 8 shows simulated bull (or steer) and heifer weaning weights. Variables were held at mean values. As expected, first-calf heifers and young cows wean lighter calves because younger cows are still growing and likely not producing as much milk as older, mature cows. The weaning weights peak at dam age 5-7. As expected, heifer weaning weights are lighter than steer calf weaning weights. For Angus sire and dam, there was a 66-73 pound difference in weaning weights between heifer and steer calves. For both red Angus dam and sire and Aberdeen dam and sire, there was a 37-42 pound difference between heifer and steer calves. For an Angus sire and a Red Angus dam or a Red Angus sire and Angus dam, heifer calves were only 11-16 pounds lighter than steer calves.

Table 8. Simulated Steer and Heifer Calf Weaning Weight (lb)

Dam:		-----------AN*-----------			-------------AR------------			-----------LO----------		
Sire:		AN	AR	LO	AN	AR	LO	AN	AR	LO
Cow Age	Calf Sex									
	Bull	664	604	560	586	613	540	529	556	483
2	Heifer	591	589	518	571	571	498	496	514	441
	Bull	668	602	560	591	611	540	547	569	496
3	Heifer	602	593	520	580	571	500	516	529	459
	Bull	677	609	567	600	617	545	556	573	503
4	Heifer	606	597	527	586	578	512	525	534	465
	Bull	681	613	571	600	622	549	560	578	509
5	Heifer	611	602	531	589	582	516	527	538	470
	Bull	681	615	573	602	622	551	558	580	509
6	Heifer	611	604	534	591	584	518	527	540	470
	Bull	679	613	573	602	624	551	558	578	509
7	Heifer	609	602	534	591	584	518	527	540	470
	Bull	677	611	567	597	620	545	553	575	505
8	Heifer	609	597	527	586	580	514	523	536	465
	Bull	670	602	564	593	613	542	549	569	500
9	Heifer	602	591	525	582	573	512	518	529	461
	Bull	661	595	553	584	604	536	540	560	492
10	Heifer	591	584	514	571	564	503	509	520	452

*AN=Angus; AR=Red Angus; LO=Aberdeen.

Simulated Revenues

Per head weighted average revenue by dam and sire breed are given in Table 9. As expected, Revenue per head has a similar pattern as calf weaning weights. Angus sire and dams earned, on average, $47 more than Red Angus dams and $99 more than Aberdeen dams. On average, Red Angus dams and Sires earned $14 more revenue per head than Angus dams and $70 more than Aberdeen dams. On average, Aberdeen dams and sires generated $39 less revenue per head than Angus dams and $55 less than Red Angus dams. Table 10 provides the weighted average culling values per cow by breed. On average, Angus cows received $134 in revenue per cow at culling, while Red Angus cows receive $7 dollars less and Aberdeen cows receive $24 less, with the differences due to cull weights

Table 9. Per Head Weighted Average Revenue by Dam and Sire breed ($/hd)

Dam:	-----------AN*-----------			-------------AR------------			-----------LO----------		
Sire:	AN	AR	LO	AN	AR	LO	AN	AR	LO
	758	711	659	698	712	642	647	663	609

*AN=Angus; AR=Red Angus; LO=Aberdeen.

Table 10. Weighted Average Culling Value by Dam Breed ($/hd)

Dam:	Angus	Red Angus	Aberdeen
	134	127	110

Simulated Costs

Acre of native pasture required, pounds of native hay, and pounds of 20% range cubes results followed the same pattern as the cow weights by breed tables. In Table 11, the weighted average[1] required acres of native pasture per head over seven months were nearly 27.3 acres for Angus, 25.8 acres for Red Angus, and 22 acres for Aberdeen cows. In Table 12, the weighted average required pounds of native hay per head over five months were 5,991 pounds for Angus, 5,710 pounds for Red Angus, and 5,044 pounds for Aberdeen cows. In Table 13, Angus cows required nearly 446 pounds of 20% Range and Breeding cubes, while Red Angus required 529 pounds, and Aberdeen required 732 pounds per year. Tables 14-16 provide spring native grazing, native hay feeding, and cube feeding expenses per head by dam breed. Table 17 provides the combined feed expenses showing Angus cows, on average, cost $813 to feed per year, while Red Angus cows required $784 in feed costs, and Aberdeen cows required $718. It was assumed that one bull was needed for every 25 cows. Per head costs for owning a bull was estimated to be $50, assuming a bull cost $3,000 with a $1000 salvage value, depreciated over five years, and required $850 in feed and veterinary expenses annually. Veterinary and market expenses for cows was assumed to be $15 per head.

[1] Weighted by the age distribution of cows.

Table 11. Spring Native Grazing Requirements (acres/hd) by Dam Breed*

Age	Angus	Red Angus	Aberdeen
1	13	12.2	11.5
2	22	20.5	16.7
3	23.3	21.9	18.1
4	24.4	22.9	19.3
5	25.2	23.8	20.2
6	25.9	24.5	20.9
7	26.3	24.9	21.4
8	26.6	25.2	21.7
9	26.6	25.3	21.8
10	26.5	25.2	21.6
Weighted Average	27.3	25.8	22

*Assumes a seven-month native grazing feeding period.

Table 12. Native Hay Feeding Requirements (lb/hd) by Dam Breed*

Age	Angus	Red Angus	Aberdeen
1	3,273	3,150	3,019
2	4,862	4,590	3,930
3	5,089	4,830	4,173
4	5,284	5,020	4,372
5	5,430	5,177	4,539
6	5,547	5,295	4,660
7	5,627	5,377	4,751
8	5,676	5,424	4,798
9	5,687	5,438	4,815
10	5,668	5,419	4,792
Weighted Average	5,991	5,710	5,044

*Assumes a five-month hay feeding period.

Table 13. Range Cube Feeding Requirements (lb/hd) by Dam Breed*

Age	Angus	Red Angus	Aberdeen
1	916	957	1000
2	418	501	705
3	350	428	629
4	291	370	567
5	248	323	516
6	213	288	479
7	193	264	452
8	183	249	437
9	180	245	432
10	184	251	439
Weighted Average	446	529	732

*Assumes a twelve-month cube feeding period.

Table 14. Spring Native Grazing Expense ($/hd) by Dam Breed*

Age	Angus	Red Angus	Aberdeen
1	259	245	229
2	441	410	335
3	466	437	362
4	488	459	385
5	505	476	404
6	518	490	418
7	527	499	428
8	532	504	433
9	533	506	435
10	530	504	433
Weighted Average	547	515	440

*Assumes a seven-month grazing feeding period.

Table 15. Native Hay Feeding Expense ($/hd) by Dam Breed*

Age	Angus	Red Angus	Aberdeen
1	108	104	100
2	160	151	130
3	168	159	138
4	174	166	144
5	179	171	150
6	183	175	154
7	186	177	157
8	187	179	158
9	188	179	159
10	187	179	158
Weighted Average	198	188	166

*Assumes a five-month hay feeding period.

Table 16. Range Cube Feeding Expense ($/hd) by Dam Breed

Age	Angus	Red Angus	Aberdeen
1	140	146	153
2	64	77	108
3	54	65	96
4	45	57	87
5	38	49	79
6	33	44	73
7	30	40	69
8	28	38	67
9	28	38	66
10	28	38	67
Weighted Average	68	81	112

Table 17. Total Feed Expense ($/hd) by Dam Breed

Age	Angus	Red Angus	Aberdeen
1	507	495	482
2	665	638	572
3	688	662	596
4	707	681	616
5	722	697	633
6	734	708	645
7	742	717	654
8	747	721	659
9	748	723	660
10	746	721	658
Weighted Average*	813	784	718

*Includes feed costs for one-year-old replacements.

Maximum Returns to Fixed Costs, Labor, and Management

As expected, dam and sire breeds who weaned heavier calves, received higher returns per head. Dam and sire breeds that were smaller framed and weighed less required less pasture, hay, and protein supplements on average. Table 18 reports the weighted average returns ($/hd) by dam and sire breed and crested wheat grass yield (lb/acre). For each crested wheat grass yield, Angus dams and sires brought in the highest returns per head. For 1,800 pound grass yield, Angus dams and sires returns averaged $14.50 per head. Angus-sired herds generated more gross revenue per head than the herds who were sired by Red Angus or Aberdeen bulls. An Angus sire with Red Angus dams generated, on average, $39 less per head and an Angus sire with Aberdeen dam herd generated $40 less than Angus sire and dams,

When crested wheat grass pasture yields are increased to 2,200 pounds, each herd has positive returns by dam and sire breed. Red Angus dams and Red Angus sires, on average, return $83 per head while Red Angus sires with Angus dams produced $17 per head less and Aberdeen dams $13 less. The average Aberdeen sire and Aberdeen dam herd returns per head were $15 a year, while Aberdeen sires with Red Angus dams were $2 less and with Angus dams $1 less.

Because ranches are constrained by grazing acres, net returns per head is an insufficient measure of profitability. Rather, the ability to generate higher returns per acre is the appropriate metric as in equation 1. So, the returns per head reported in table 18 were divided by the acres required per head to generate returns per acre.

Table 19 provides weighted average returns per acre by dam and sire breed and crested wheat grass yield (lb/acre). For 2,200 pound crested wheat grass yield, on average, Angus sire and dams had $1.79 higher returns per acre than Red Angus dams and $2.06 higher returns than Aberdeen dams. Red Angus sires and Red Angus dams produced $0.05 higher returns per acre than with Aberdeen dams and $0.97 higher returns than with Angus dams. Aberdeen sires with Aberdeen dams produced $0.24 higher returns per acre than Angus dams and $0.25 higher than Red Angus dams. For 2,200 pound crested wheat grass yield, on average, the highest returns per acre herd is $5.05 with Angus sires and Angus dams.

Regardless of dam and sire breed, there is little to no difference between breed weighted average returns per acre. This study did not employ stochastic simulation, so formal statistical analysis of the final results is not possible. However, given the small difference in returns per acre and the error terms from the regression modeling, it is not likely the differences reported are statistically significant.

Table 18. Weighted Average returns ($/hd) by Dam and Sire
Breed and Crested Wheat Grass Yield (lb/ac)

Dam:	-----------AN*-----------			-------------AR------------			-----------LO----------		
Sire:	AN	AR	LO	AN	AR	LO	AN	AR	LO
Grass Yield									
1800	14.50	-32.31	-84.91	-24.09	-10.01	-80.34	-25.46	-9.53	-64.03
1900	42.41	-4.41	-57.00	2.21	16.29	-54.04	-3.01	12.92	-41.58
2000	68.35	21.53	-31.06	26.65	40.73	-29.60	17.85	33.78	-20.72
2100	91.81	45.00	-7.60	48.77	62.84	-7.48	36.72	52.65	-1.85
2200	113.15	66.33	13.74	68.87	82.95	12.62	53.88	69.81	15.31

*AN=Angus; AR=Red Angus; LO=Aberdeen.

Table 19. Weighted Average returns ($/ac) by Dam and Sire
Breed and Crested Wheat Grass Yield (lb/ac)

Dam:	-----------AN*-----------			-------------AR------------			-----------LO----------		
Sire:	AN	AR	LO	AN	AR	LO	AN	AR	LO
Grass Yield									
1800	0.53	-1.18	-3.11	-0.94	-0.39	-3.12	-1.16	-0.43	-2.91
1900	1.64	-0.17	-2.20	0.09	0.67	-2.21	-0.14	0.62	-1.99
2000	2.77	0.87	-1.26	1.15	1.75	-1.27	0.90	1.70	-1.05
2100	3.91	1.92	-0.32	2.21	2.84	-0.34	1.95	2.79	-0.10
2200	5.05	2.96	0.61	3.26	3.93	0.60	2.99	3.87	0.85

*AN=Angus; AR=Red Angus; LO=Aberdeen.

CHAPTER V

CONCLUSIONS

Conclusion

This study investigated the differences in cow-calf profitability between Angus, Red Angus, and Aberdeen herds due to calving weight, calving interval, weaning weight, and feed expense. Regression models of calving weights, calving intervals, and calf weaning weights were estimated by cow breed. Using these models, revenues by dam and sire breed were simulated for ten years of price data. Pasture, hay, and protein supplementation needs were estimated using Cowculator (Lalman et al. 2010) and associated feed costs were calculated by breed. Returns to overhead were computed by sire breed and dam breed, resulting in nine sire by dam breed returns for ten years.

Results indicate Angus and Red Angus influenced cows generate higher revenue per head than Aberdeen, however associated feed expenses are also higher. Returns measured in dollars per head per acre were highest for herds sired by Angus or Red Angus bulls. Overall, the highest returns in dollars per head per acre were found with Angus dams bred to Angus bulls. However, the difference in returns between dam breeds for a given sire breed, statistically, have little to no difference.

Implications

U.S. beef cow herd weights have steadily increased (Wiseman et al. 2018), leading to increased weaning weights. Bir et al. (2018) found lighter weight cows are more profitable than heavier weight cows. Smaller cows require less forage than larger cows, so stocking rates are higher. As the Aberdeen breed was selected for lighter weights, Aberdeen-influenced cow-calf profits are competitive to their Angus and Red Angus cousins. So, Aberdeen-influenced herds can assist in downsizing cow sizes without sacrificing herd profits.

Study Limitations

Diet information was not gathered by Dickinson Research Extension Center, therefore dietary data by herd breed was not available for this research. The CowCulator program (Lalman et al. 2010) was used to approximate rations, but data are needed to understand differences in nutritional efficiencies between the breeds studied here.

Longevity affects the overall productivity of a cow in livestock production. The longevity of a beef cow is reflected by her performance over her entire herd life and is determined by her fertility, maternal ability, health, and ability to avoid being culled (Martinez, 2003). Martinez et al. (2003) estimated heritabilities and sire breeding values for stayability and reproductive traits in multi-breed beef cattle. Martinez et al. (2003) concluded sires chosen for genetic merit might assist in the likelihood of their daughters being retained as replacement heifers for herd improvement. However, the data used here did not allow investigating differences in Angus, Red Angus, stayability and economically-relevant reproductive traits (e.g., dystocia). Further, there are no known studies comparing feedlot performance and carcass merit relative to the Aberdeen breed. This study did not evaluate the downstream performance of each breed.

This study only considered a point estimate of each breed's relative economic cow-calf performance. That is, mean values of cow characteristics by breed were used to simulate economic returns. The study used one data set evaluating three herds by breed, which could have over time selected for different traits than would be typical for each breed. However, heterogeneity within breeds may be important factors to decision makers. As most producers are risk averse, more variable economic returns reduce producer welfare. A more in depth investigation is needed to evaluate the relative riskiness of the three Angus-derived breeds. The study only concedes point estimate … Because we only have one herd of Red Angus and Angus, they might have done things over time to select for different traits than would be typical for the breed.

Calving interval variation between breeds was not considered due to the stochastic simulation. If one dam breed has a more variable calving interval, then the calf crop will be more heterogeneous, lowering sale price.

Some of the expected values from this paper could be an approximation due to nonlinearities. For this research, variables were held at mean values except for sire and dam breeds, which were varied across the three breeds. Since this research did a point estimate for cow weight by breed, the calf revenue from heavier breeds may be overvalued. Point estimates for cow weight by breed was also used when looking at feed costs, so feed requirements may be overstated for heavier cows.

This research only consider data from one location, Dickinson (North Dakota) Research Extension Center. Western North Dakota's climate is challenging for beef cow producers. Drought is common and winters are harsh. Alternative climates and forages may generate different conclusions compared to this study. Generalizing these results to other locations may not be warranted.

REFERENCES

American Angus. 2020. “Angus History.” American Angus Association. https://www.angus.org/Pub/AngHist.aspx. (Accessed March 15 2020).

Amundson, O. 2020. “Tightening Up Calving Season.” SDSU Extension. https://extension.sdstate.edu/tightening-calving-season (Accessed February 27 2020).

Azzam, S.M., A.M. Azzam, M.K. Nielsen, and J.E. Kinder, J. 1990. "Markov chains as a shortcut method to estimate age distributions in herds of beef." Journal of Animal Science 68: 5-14.

Barnett, D. “History.” 2020. American Aberdeen. https://americanaberdeen.com/history/. (Accessed March 15 2020).

Bir, C.A., E.A. DeVuyst, M. Rolf, and D. Lalman, 2018. “Optimal Beef Cow Weights in the U.S. Southern Plains,” Journal of Agricultural and Resource Economics, 43: 103-117.

Brown, L.O., R.M. Durham, E. Cobb, and J.H. Knox. 1954. “An Analysis of the Components of Variance in Calving Intervals in a Range Herd of Beef Cattle.” Journal of Animal Science, Volume 13, Issue 2, Pages 511–516

Carpenter, B., and L.R. Sprott. "Long Calving Seasons: Problems and Solutions – When Can Cows Breed?" Texas A&M AgriLife Extension Service. https://agrilifeextension.tamu.edu/library/ranching/long-calving-seasons-problems-and-solutions/. (Accessed March 31 2020).

Cook, C.W., and L.E. Harris. 1952. "Nutritive Value of Cheatgrass and Crested Wheatgrass on Spring Ranges of Utah." Journal of Range Management 5, no. 5: 331. https://doi.org/10.2307/3894038.

DeVuyst, E., J.R. Bullinger, M.L. Bauer, P.T. Berg, and D.M. Larson. 2007. "An Economic Assessment of Genetic Information: Leptin Genotyping of Breeding Cattle." Journal of Agricultural and Resource Economics Vol. 32, No. 2 pp. 291 -305

Doren, P.E., C.R. Long, and T.C. Cartwright. 1986. "Factors Affecting the Relationship Between Calving Interval of Cows and Weaning Weights of Calves." Journal of Animal Science 62:1194–1202.

Frazier, E.L., L.R. Sprott, J.O. Sanders, P.F. Dahm, J.R. Crouch, and J.W. Turner. 1999. "Sire marbling score expected progeny difference and weaning weight maternal expected progeny difference associations with age at first calving and calving interval in Angus beef cattle." Journal of Animal Science 77:1322–1328.

Flores, A. "A study of calving interval". 1971. Retrospective Theses and Dissertations 4452.

Howard, J. 2013. "A Shorter Calving Season Can Result in Greater Profits." Progressive Cattleman. https://www.progressivecattle.com/topics/reproduction/a-shorter-calving-season-can-result-in-greater-profits (Accessed February 15 2020).

Lalman, D and D. Gill. 2010. “CowCulator”. http://www.beefextension.com/new%20site%202/cccalc.html

Livestock Marketing Information Center, Cull Cow and Bull Prices, 2020. LMIC.info. (Accessed April 6 2020).

Livestock Marketing Information Center, Steers and Heifers Medium and Large Frame #1 Prices, 2020. LMIC.info. (Accessed January 24 2020).

MacGregor, R.G., and N.H. Casey. “The Effects of Maternal Calving Date and Calving Interval on Growth Performance of Beef Calves.” 2000. South African Journal of Animal Science 30: 70–76.

Martinez, G., S.D. Kachman, and L.D. Van Vleck. 2003. “Threshold Sire Models for Estimating Genetic Parameters For Stayability In Beed Cows.” Conference on Applied Statistics in Agriculture, Kansas State University.

Meehan, M., K.K. Sedivec, J. Printz, and F. Brummer. 2018. “Determining Carrying Capacity and Stocking Rates for Range and Pasture in North Dakota.” NDSU Extension Service. https://www.ag.ndsu.edu/publications/livestock/determining-carrying-capacity-and-stocking-rates-for-range-and-pasture-in-north-dakota. (Accessed April 6 2020).

Miller, A.J., D.B. Faulkner, R.K. Knipe, D.R. Strohbehn, D.F. Parrett, and L.L. Berger. 2001. "Critical control points for profitability in the cow-calf enterprise." The Professional Animal Scientist 17.4: 295-302.

Mitchell, J., E. DeVuyst, M.L. Bauer, and L.L. Daniel. 2009. “Cow-calf profitability and leptin genotyping.” American Journal of Agricultural Economics. 40. 113-118.

Oklahoma State University. 2015. “Breeds of Livestock, Department of Animal Science.” Breeds of Livestock - Red Angus Cattle - Breeds of Livestock, Department of Animal Science. http://afs.okstate.edu/breeds/cattle/redangus/index-2.html (Accessed March 20 2020).

Ringwall, C. 2020. “500 Pounds Weaned Per Cow Exposed, A New CHAPS Bench-” North Dakota State University Extension Service. https://www.ag.ndsu.edu/dickinsonrec/documents/grassland/beeftalk-articles/bt261.pdf. (Accessed April 21 2020).

SAS Institute Inc. 2012. SAS Enterprise Guide 5.1. SAS Institute Inc., Cary, North Carolina.

Sedivec, K.K., D.A. Tober, W.L. Duckwitz, D.D. Dewald, and J.L. Printz. 2020. “Grass for the Northern Plains – Volume 1-Cool-Season.” NDSU Extension Service.

Stillwater Milling Company. 2020. “20% Range and Breeder Cubes.” Stillwater Milling Company. Available at: https://www.stillwatermill.com/index.cfm?show=10&mid=41 (Accessed March 20 2020).

Titterington, F.M., F.O. Lively, S. Dawson, A.W. Gordon, and S.J. Morrison. 2017. “The Effects of Breed, Month of Parturition and Sex of Progeny on Beef Cow Fertility Using Calving Interval as a Measure.” Advances in Animal Biosciences 8, (October 2017): 67–71.

USDA. “Quick Stats North Dakota Native Hay Prices” 2019. Available online at https://quickstats.nass.usda.gov/results/CC941D23-D38A-313F-A628-FB7AD88CDEC4. (Accessed on April 1 2020).

USDA. “Quick Stats North Dakota Native Pasture rent” 2019. Available online at https://quickstats.nass.usda.gov/results/BAC9911D-10C3-306A-8A51-5B0055E3B343.(Accessed on April 1 2020).

Ward, C.E., C.D. Ratcliff, and D.L. Lalman. 2017. “Price Premiums from the Oklahoma Quality Beef Network – 2001-2003.” Oklahoma Cooperative Extension Service. http://pods.dasnr.okstate.edu/docushare/dsweb/Get/Document-1767/AGEC-599web.pdf. (Accessed March 23 2020).

Wiseman, A., D. Lalman, and E. DeVuyst. 2018. “Mature Cow Size Considerations.” Oklahoma Cooperative Extension Service. http://dasnr22.dasnr.okstate.edu/docushare/dsweb/Get/Document-10933/ANSI-3301web.pdf. (Accessed February 27 2020).

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