The Economics of Reproductive Beef Management

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Introduction

The purpose of this paper is to present a case study of the economic importance of reproductive management in a beef herd. Deseret Ranches, Ltd., of Alberta, Canada, have provided their computerized records for use in this project.

Unlike the dairyman, the beef breeder derives most of his income from calves born into the herd, making fertility the most important trait. A recent economic study showed that fertility was five times more important than growth rate and ten times more important than carcass quality.[1]

The two major goals of reproductive management are: Increase the number of females in estrus early in the breeding season, and improve conception rates.[2,5] In order to address these goals, a brief description of the physical ranch management practices must be given. This will be followed by a description and comparison of the reproductive management practices before (Program 1) and after (Program 2) the implementation of a veterinary supervised reproductive herd health program. The comparison will deal specifically with the economic efficiency of each program in striving to attain the two stated major goals.

Deseret Ranches, Ltd, 96,000 acre beef ranch is located in southern Alberta, approximately 25 miles north of the Montana border. The total acreage is subdivided into five smaller ranches to facilitate management and segregation of the some 6,000 head of beef cows. The cows are grouped according to age parity and breed. Purebred Angus and Angus-Hereford cross heifers are retained as replacement females. The 1,500 heifers are pastured at the bar K-2 away from the mature cows and are segregated into herds of first and second calf heifers. The 4,500 remaining mature cows (≥ 4 yrs) are evenly distributed among the other four ranches (Knight, Deerhaven, Kircaldy and Horseshoe). To service the cows, 200 purebred Angus, Hereford, and Charolais bulls are used. The Charolais bulls are used as a terminal cross with the mature cows. All Charolais-cross calves (male and female) are sold in the fall.

There are two major pasture types maintained on the ranches, native prairie grass and improved pasture. The improved pasture is grassland that has been broken up and reseeded with a mixture of the native grass and fescue, fairview crested wheat, trek and Alberta wild rye seed. Barley is planted as a cover crop the first year. Eventually, all natural pastures will be broken up and reseeded to improve forge quality. During the winter, pelleted grain, hay, straw and, occasionally, green feed is supplemented as weather conditions dictate.

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Reproductive Management Programs

The following is a description of the two reproductive management programs that will be compared for economic return.[3]

	Program 1 (1966-1982)	Program 2 (1983-1986)
Nutrition summer	Pasture	Pasture
winter	Pasture, hay, grain pellets, straw	Pasture, hay, grain pellets, straw
Breeding Season	90 days	45 days
heifers	June 1	June 1
cows	June 20	June 20
Pregnancy Exam post-breeding season	Only cows that did not calve that spring are done at weaning	All heifers & cows done at time of weaning
Bull Breeding Soundness Exam	Not done	All bulls evaluated for internal & external genital development and scrotal circumference, semen evaluated for morphology, and motility
Bull:Cow Ratio	1:20	1:30
Vaccination	IBR, PI_3, 8 way clostridial[b] for heifers & cows retained	IBR, PI_3, 8 way clostridial, Campylobacter bacterin,[a] Vitamin A & D for heifers & cows retained

[a] Vibrin, Norden Laboratories, Omaha, Nebraska
[b] Closdridium; chauvoei, septicum, novyi, sordellii, perfringens C & D, hemolyticum basterin.

Increasing cows Cycling Early

As stated previously, the first major goal of reproductive management is to increase the number of females in estrus early in the breeding season. The goal should be to have 90%

of the cows and 85% of the heifers cycling in the first 21 days of the breeding season.[5,6]

To accomplish this, many factors are involved. To begin the case study, Programs 1 and 2 will be compared according to: nutrition, length of post-calving period before rebreeding, time of calving, breeding season, size of heifers at first breeding, and, pregnancy examination after the breeding season. The differences of the two programs in managing these factors will be demonstrated by the efficiency with which each increases the number of cows cycling early.

Nutrition: it has been reported that 45%-91% of good-condition cows will be cycling in the first 21 days of the breeding season. This figure contrasts with 28% of thin or 37% of moderate-condition cows cycling in the same period.[4,7] It has also been shown that low energy rations fed prior to calving not only increases the incidence of dystocia and early calfhood problems, but also delays rebreeding rates.[4,5,8] This ultimately results in lower calf weaning weights and, therefore, decreased economic return at weaning. On the Deseret Ranch, these important aspects of nutrition are understood. There have been few changes in nutritional management between Programs 1 and 2, with both having equally good nutrition.

The cows are pastured on native grass and improved pasture. More importantly, during the winter months, especially December through early March, the cows are supplemented with grain pellets, hay and straw. This supplementation maintains good nutrition during the critical third trimester of pregnancy and during the breeding season. It also provides energy for growth of the first and second calf heifers during pregnancy. This results in the cows being in moderate to good condition for the breeding season, and avoids the explained potential decreases in the number of cows cycling. Since the nutritional program has not changed from Program 1 to Program 2, no difference in the number of cows cycling early due to nutritional factors alone should be expected between the two programs.

Calving/Breeding Interval: The time between calving and the start of the breeding season also influences the number of cows cycling early. Wiltbank, and others, reported on the length of time post partum and the percentage of good-nutrition heifers and cows which were in heat.[5,7,8]

TABLE 1. Good body condition at calving and percent cycling in the Post Partum Period.[7]

Days post partum	% cycling: 1st calf heifers	% cycling: cows
40	15	30
50	24	53
60	47	72*
70	62	82
80	68	89
90	69	94

*91% of good-condition cows were reported cycling at 60 days by Rice.

These results re-emphasize the need for good nutrition and point out the need for at least 50-60 days between calving and the breeding season. This will allow an increased number of cows the necessary time to clean and be cycling early in the breeding season. Consequently, with good management elsewhere in the program, more cows will become pregnant on the first cycle and will calve earlier the following year. This, in turn, will increase weaning weights of the calves since they gain approximately 1.6 lb per day while with their mothers.

Breeding Season: The timing and duration of the breeding season is also economically critical for the same reasons. The breeding season should be timed so calves will be born early in the spring, mid-March through April. This will allow more time for growth before weaning and, therefore, increase average weaning weights. For every 20-21 days earlier that a cow becomes pregnant in the breeding season, her calf will wean 30-40 lbs heavier.[5] The duration of the breeding season is just as important. The recommended maximum duration is sixty days for cows and forty-five days for heifers.[5,8] The heifer breeding season should also begin 20 to 30 days before the cow herd. Heifers that become pregnant early the first time will have a better chance of breeding back early in the future. A shortened breeding season of this type serves to tighten up the duration of the calving season resulting in a more uniform calf crop. It will also provide the time Wiltbank reported necessary for cows to recover and start cycling. In summary, a breeding season that is timed for early calving and short duration will: increase average weaning weights, increase the number of heifers calving early, provide a more uniform calf crop, and increase the number of cows cycling early in the next breeding season.

Obviously, nutrition, time between calving and breeding, and the actual breeding season are highly interrelated. The effects they have on the number of cows cycling early in the breeding season are also integrated. The following tables show the results from the two different ways in which these parameters were managed. Since rectal palpation was not performed during the breeding season, calving patterns are used as the best available indicator of cycling females.

TABLE 2. 50-day interval between calving/breeding and percent of females calving.

	Program 1		Program 2	
	1st Calf Heifers	Cows	1st Calf Heifers	Cows
% w/ > 50-day calving/breeding interval	66.4%	75.5%	84.0%	85.2%

TABLE 3. Calving pattern as indicator of early cycling during the breeding season.

	Program 1 1980		Program 2 1986	
	1st Calf Heifers	Cows	1st Calf Heifers	Cows
Beg. Calving Date	March 17	March 23	March 15	April 1
No. Calves Born During				
1st week	10	7	111	1025
2nd	31	56	215	830
3rd	56	99	161	942
4th	29	101	69	636
5th	15	91	45	382
6th	14	40	20	226
7th	6	27	0	153
8th	1	29	0	60
9th	4	32	0	0
10th	2	14	0	0
Total	168	495	621	4254

TABLE 4. Calving pattern of cows that calved as an indicator of early conception in the breeding season.

	Calving Pattern			
	Program 1 1980		Program 2 1986	
	1st Calf Heifers	Cows	1st Calf Heifers	Cows
% born				
1st cycle	57.8%	32.7%	78.4%	65.8%
2nd	34.5%	46.9%	21.6%	29.2%
3rd	6.5%	17.8%	0%	5.0%
4th	1.2%	2.6%	0%	0%

The shorter breeding season of Program 2 resulted in 17.6% more heifers and 9.7% more cows having the recommended 50 days between calving and breeding (Table 2). It should also be noted that of those females calving closer than 50 days to the breeding season, 7.7% of the heifers from Program 1 calved within 30 days of the June 1st starting day. In Program 2, all the heifers completed calving the last week of April and, therefore, had at least 30 days between calving and breeding. Of the cows in Program 1, 9.1% calved within 30 days of the breeding season versus just 1.4% of the cows in Program 2 (Table 3).

The increased number of females cycling early due to the shorter breeding season and improved interval between calving and breeding is shown in Table 4. Twenty percent (20.6%) more heifers and 33.1% more cows from Program 2 had calves corresponding to first cycle conceptions. By using the total number of heifers and cows exposed to bulls in Program 2, the first cycle conception rate can also be calculated, respectively, for heifers and cows.

Heifer Size at First Breeding: It has been shown that less than 30% of the well-fed heifers will be cycling at 12 months of age, whereas 85-90% of the same heifers will be cycling at 15 months of age.[5] It has, therefore, been recommended that the heifers be bred when they reach approximately 65% of the adult body weight (13-15 mo. of age). With Program 2 of this study, more calves are born earlier in the spring (Tables 3 and 4). This allows an increased number of the heifer calves retained as replacements to reach 13 and 14 months of age at the beginning of the breeding season. The contribution of these factors to the increased number of heifers cycling early is also reflected in the 78% first-cycle calving rate of the heifers in Program 2 versus the 57.8% rate of heifers in Program 1.

Pregnancy Exam: One of the ways to increase economic efficiency is to decrease costs incurred. The best way to minimize costs over wintering is to eliminate all cows diagnosed non-pregnant or late-calvers by rectal palpation. Deseret Ranches did a feeding trial with 400 heifers to be retained as replacements. The average costs to maintain and feed these heifers from the last week of October, 1985 to May 7, 1986, was $159.00 (Canadian) each. In September, 1986, 62 of the heifers (15.5%) were diagnosed as non-pregnant and culled from the herd. The resultant decreased cost for the upcoming winter, assuming similar maintenance and feeding costs, is $9,858.00 (62 x $159.00).

A comparison of the calf weaning percentage (number of calves weaned/cow exposed or retained) also indicates the benefits of pregnancy determination by rectal palpation of all cows in a herd. The average weaning percentage in Program 1 for cows exposed to a bull was 76.9% (Table 5). This is consistent with the overall U.S. average of 74%. By rectally examining cows that did not calve and using the other culling criteria described for Program 1, the average weaning percentage for cows retained was 84.3%. In Program 2, where all cows were examined rectally for pregnancy, the weaning percentage improved from 80.4% for cows exposed to 92.1% for cows retained (Table 5). The weaning percentage for cows retained in Program 2 is approaching the optimum goal overall of weaning a 95% calf crop[5] and is 7.9% higher than Program 1.

TABLE 5. Total number of calves weaned as a percent of cows exposed and cows retained.

	Calves Weaned	Cows Exposed	Cows Retained	% Culled
Program 1 (1966-1982)	58,953	76,611* (76.9%)	69,928 (84.3%)	8.7
Program 2	15,183	18,885 (80.4%)	16,489 (92.1%)	12.7

*Includes estimates of cows exposed in 1979, 1980, and 1981 since actual records are unavailable.

To further maintain high numbers of cows cycling early in the breeding season, rectal pregnancy determination should also be used to cull cows that will calve late in the spring.

In this case study, the implications of this practice cannot be evaluated accurately since all cows were not rectally examined in Program 1, and the short breeding season of Program 2 eliminates late-calvers. The importance of culling late calving cows should, however, be remembered as a useful tool to increase the number of cows cycling early in herds with longer breedings seasons or herds converting over to shorter breeding seasons.

The results of the comparison of Programs 1 and 2, based on the six factors discussed, indicate that Program 2 was more efficient than Program 1, in terms of increasing the number of cows cycling early.

Increasing Conception Rates

The second major goal of reproductive management is to increase conception rates. Once high numbers of females cycling early is established, two other reproductive management practices contribute to conception rates: infectious disease prevention and bull breeding soundness examination.[10 11]

Infectious Disease Prevention. The reported major infectious causes of reproduction failure in beef cows are campylobacteriosis,[12] trichomoniasis,[13, 14] leptospirosis,[15] infectious bovine rhinotracheitis,[16] and bovine viral diarrhea.[17] In this case study, no specific follow-up of causes of reproductive failures in non-pregnant cows has been done in either Program 1 or 2. The practices of culling older bulls and cows, plus vaccination for the reproduction inhibiting diseases prevalent in the vicinity, have been relied upon to control infectious causes of infertility. The addition of the campylobacter bacterina to the vaccination routine in Program 2 may or may not have contributed to the increased percentage of calves weaned/cows exposed (Table 5).

Perhaps some investigation into the causes of reproduction failure and cows being culled from the herd would be of merit.

Bull Breeding Soundness Exams: Variation in bull fertility has a marked effect on reproductive efficiency in a cow herd, especially since goals for pregnancy rates should be 85% for heifers and 95% for cows after their respective breeding season.[5] Nebraska and Texas studies have reported 9% and 6% increases, respectively, in herd pregnancy rates when bulls tested as satisfactory breeders,[18] according to Society for Theriogenology guidelines.[10] The bulls in these reports were evaluated similarly to the bulls of Program 2 of this study. Both were on the basis of scrotal circumference, percent morphologically normal sperm, and sperm motility. The bulls were tested each year prior to the breeding season. The same trends published seem to hold true in this case. The weaning percent of all cows exposed to bulls in Program 2 versus Program 1 shows an increase of 3.5% (Table 5, statistically significant at $p<0.01$). Although disease control and more cows cycling early contribute to this increase, it should be noted that the increase in pregnancy rate occurred during the same time that actual bull numbers were decreased from 300 to approxi-mately 200. Program 1 was using approximately 1 bull to 20 cows. Program 2 has stretched the bull power to a 1:30 cow ratio while still increasing overall pregnancy rates. This supports the reported ability of satisfactory bulls evaluated for scrotal circumference, semen morphology and motility to increase herd pregnancy rates.

Age of heifers at puberty is also correlated with sire scrotal circumference. Heifers sired by bulls with larger than average testicle size tend to reach puberty earlier than daughters of bulls with a small scrotal circumference.[10,11] Although this cannot be accurately evaluated alone in this case study, it may have contributed to the increased percentage of heifers cycling early in Program 2.

Again, the results of the comparison favor Program 2 for increasing conception rates, especially since bull breeding soundness exams were not routinely performed in Program 1.

Economic Summary

The actual cash income of a beef herd is from the pounds of beef weaned and sold. Therefore, a common way of evaluating the efficiency of the operation is in terms of pounds of calf weaned per cow unit.[5] This way of measuring production is affected by weaning weights, pregnancy rate and calf mortality. Since the six ways to increase the number of females cycling early described, in this case study, ultimately should result in increased, uniform weaning weights, the lbs weaned/cow unit will reflect the success of the herd health program. Pregnancy determination and removal of open cows dramatically affects this figure. Similarly, the conception rate determines the pregnancy rate and is also expressd by lbs weaned/cow. The weaning weight is also affected by range conditions and climate. In order to confine this paper to reproductive management practices, calf mortality problems cannot be given adequate coverage here.

TABLE 6. Calf average weaning wt. and lbs. weaned/cows retained.

	No. of calves	Average weaned wt.	lbs. weaned/cow retained
Program 1 (overall 1966-1982)	58,953	406.6	347.4
Program 1 (1977-1982)	21,157	452.4	389.6
Program 2 (1983-1985)	15,183	454.0	418.0

When Programs 1 and 2 are compared on this basis, even when conditions result in similar average weaning weights, the lbs weaned per cow is 28.4 lbs more with Program 2 (Table 6). This increase can easily be accounted for by using the figures from Table 5 and an example with the original herd having 6,000 head of cows and heifers. In Program 1, by subtracting the number of cows culled from the original herd, the retained herd size would be 5,478 [6,000 - (6,000 x 0.087)]. Program 2 would have a retained herd size of 5,238 [6,000 -(6,000 x 0.127)] or 240 fewer cows than Program 1. If the retained herd size is then multiplied by the percentage of calves weaned, the number of calves weaned in Program 1 would be 4,618 (5,478 x 0.843). Program 2 would wean 4,824 calves (5,238 x 0.921), which is 206 more calves weaned than Program 1. In other words, Program 2 would wean 206 more calves from a herd with 240 fewer cows due to the increased reproductive efficiency of the management practices. The increased efficiency in this case is primarily due to the identification and removal of non-pregnant animals and improved pregnancy rates.

In order to get an overall appreciation of the economic difference before and after the reproductive management program, a method involving "cost" changes must be used. This will also help answer the most often asked question about reproductive herd management: "Will it pay?"

When all additional returns and costs no longer incurred are summed as gross returns, and when additional costs and returns no longer obtained are subtracted from the total, the net return can be calculated. Using the same example of a herd size equalling 6,000 heifers and cows, and current prices for calves and culled cows of $1.15/lb and $0.40/lb (Canadian), respectively, the following results are obtained (Table 7). The feeding costs are on a yearly basis for mature cows except concerning the calves. The current grazing fees were used to figure calf feeding costs.[3] The figures shown represent a complete change over to Program 2.

TABLE 7. Partial Farm Budget.

I. Additional Returns	
a. Increased weaning weights (no change from Program 1 to Program 2)	$
b. Increased number of calves (Program 2 - Program 1) Number of calves = (orig. herd size — no. culled) x calving % [6,000-(6,000 x 0.127)]x0.921)- [6,000-(6,000x0.87)]x0.843 = 206 206 calves x 454.0 lbs/calf x $1.15/lb	$107,552.00
c. Sale of more cows due to heavier culling 4% more cows culled with Program 2 (Table 5) 0.04 x 6,000 x $400.00	$96,000.00
d. Sale of culled bulls (1 time return) (100 x 1,500 lbs) x $0.40/lb	$60,000.00
Total Additional Returns	$263,552.00
II. Cost No Longer Incurred	
a. Feeding costs of 4% more cows culled 240 x $175.00	$42,000.00
b. Feeding costs of culled bulls 100 x $175.00	$17,500.00
Total Cost No Longer Incurred	$59,500.00
III. Additional Costs	
a. Increased veterinary costs rectal palpation + bull breeding soundness exams (6,000 hd x $1.25/hd) + (300 hd x $15.00/hd)	$12,000.00
b. Increased labor to aid veterinarian (5 men x 14 days) x $60.00/day	$4,200.00
c. Cost of Campylobacter bacterin vaccine [6,000 - (6,000 x 0.127)] x $0.80/dose	$4,190.00
d. Feeding cost of raising 206 more calves (206 calves x 6 mo. x $12.00/anim unit mo.)	$14,832.00
e. Cost of labor to brand & tag 206 more calves (5 men x 1 day) x $60.00/day	$ 300.00
Total Additional Costs	$35,522.00
IV. Returns No Longer Obtained None	$ 0.00
Total loss of Returns	$ 0.00
Net Return (I + II) - (III + IV) [$323,052.00 - $35,522.00]	$287,530.00

Conclusion

The comparison of Programs 1 and 2, on their ability to increase the number of cows cycling early and improve conception rates, economically favors Program 2. Although the initial cost to implement a veterinary-supervised reproductive herd management program seems discouraging, the 900% return on the money invested clearly outweighs the cost. The increased economic return demonstrated in this paper is also consistent with reported returns on veterinary-supervised dairy programs.[19] In this case study, the increased efficiency of Program 2 would result in an 11.9% increase in total income over Program 1. An increase of this magnitude during economically hard times may represent the difference between a profitable business and one that does not survive. The role of the veterinary-supervised reproductive management program is crucial in maintaining profitability.

Summary and Acknowledgment

The economic advantage of a veterinary-supervised reproductive herd management program was evaluated. A comparison of economic efficiency was made using data from before and after the implementation of the program in a 6,000 cow beef herd.

The two programs were compared on their ability to increase monetary return by increasing the number of cows cycling early in the breeding season and improving conception rates. The final evaluation indicates a 9-fold (900%) return on the money invested to initiate and maintain the reproductive program.

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New Perspectives in the Serodiagnosis of Bovine Chlamydial Abortions

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Summary

The classical CF test with genus-specific chlamydial antigen has a low sensitivity and never detected the actual prevalence of chlamydial infection of cattle. Supplementation of guinea pig complement in the classical CF with bovine complement increased the sensitivity and titers. The shortcoming of the MoCF remains the genus-specificity and the difference in the reactivity of bovine immunoglobulin isotypes in the complement binding reaction.

The indirect inclusion FA test and ELISA reacting predominantly with species- and type-specific protein antigens on the surface of chlamydial elementary bodies were most sensitive. Results obtained with these two tests had a highly significant correlation. Objective spectroscopic evaluation makes the ELISA more attractive. This test has the added advantage that serum samples can be evaluated at single dilutions of 1:100 of internal positive and negative controls are used and if the test is run under quantitative conditions.

Ultrasonic Diagnosis of Pregnancy and Ovarian Function in Cattle

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Summary

Sonographic examination of early pregnant cows, using a 5 MHz transducer, enables the detection of the embryonic vesicle between day 21 and 25 of gestation. The embryo and its heart beat often is visible on the ultrasonic screen from day 28 on. Between day 35 and 40 the amniotic membrane surrounding the embryo becomes visible.

At the ovaries, follicles, corpora lutea and cystic structures can be diagnosed using sonography. Corpora lutea can first be seen between day 2 and 4 of diestrus and remain detectable until the next ovulation. They show the sonographic pattern of less echogenic tissue. Cystic Corpora lutea can be diagnosed as well. Follicles with a diameter of few millimeters sometimes cannot be observed accurately at 5MHz. Beyond a diameter of 10 mm all follicles are easy to detect. Diagnosis of ovarian cysts doesn't make problems.

Sonography has shown its potential in gynecological examinations of cattle. This technique enables diagnosis of pregnancy from week 4 of gestation and makes visualisation of ovarian structures possible.

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