

Achieving Reproductive Efficiency in Beef Cow Herds

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Abstract

Excellent reproductive efficiency can be achieved in a beef herd by using a multifaceted approach focusing on herd production and management issues. Numbers that would define reproductive efficiency for most herds would include a 90-95% pregnancy rate, less than 2% abortion rate with 65, 88, and 100% of the calves born by days 21, 42, and 65 of the calving season, respectively.

Heritability of reproductive traits tends to be low and disease causing reproductive failure in beef herds is uncommon in many parts of North America. Heifer selection and development, nutrition and utilizing heterosis are some of the keys to success. Efficiency is not synonymous with maximums, but rather is more closely aligned to 'optimums'. Recent research with cost control as the core of heifer development shows that heifers can be developed more efficiently than previously thought.

Résumé

Une très bonne efficacité de reproduction peut être obtenue dans un troupeau de bovins de boucherie en utilisant une approche à plusieurs facettes basée sur les thèmes de la production et de la régie. Une reproduction efficace devrait englober dans la plupart des troupeaux une proportion de gestation de l'ordre de 90 à 95% , un taux d'avortement annuel de moins de 2% et un pourcentage de veaux nés aux jours 21, 42 et 65 de la saison de vêlage de l'ordre de 65, 88 et 100%, respectivement. L'héritabilité des caractéristiques de reproduction n'est pas très élevée et les maladies qui causent l'insuccès de la reproduction dans les troupeaux de boucherie sont peu communes dans plusieurs régions de l'Amérique du Nord. La sélection des taures et leur développement, la nutrition et l'utilisation de l'hétérosis sont quelques éléments clés pour assurer le succès. L'efficacité n'implique pas nécessairement l'atteinte d'un maximum et se rapproche plutôt du concept de l'optimum. Des travaux récents, impliquant principalement le contrôle des coûts, dans le développement des taures indiquent que les taures peuvent être développées encore plus efficacement que l'on envisageait.

Introduction

Having a large percentage of beef calves born in a relatively short period of time will decrease labor,

enhance marketing opportunities, improve herd health, and enhance overall herd income. Herds with acceptable pregnancy rates and a short, defined calving season have achieved these results with a disciplined, deliberate plan for reproductive success.

Because beef cattle are raised across vastly different environments, specific definitions of 'reproductive efficiency' can be quite varied. Specific questions and concerns for a given environment should be addressed with individuals that are deemed to be experts in these geographic locations. The universal concepts of reproductive efficiency are the focus of this paper.

The National Animal Health Monitoring System (NAHMS) data from 2007-2008 revealed that 91.5% of exposed females calved in a given year. While this number may seem to be acceptable for some regions of North America, when it is coupled with the fact that 34% of all herds had no defined calving season and only 50.4% of herds had calves born in three or fewer months, the numbers show reason for concern. A well managed herd should be able to achieve a 90-95% pregnancy rate with a 1-2% abortion rate in 65 days.

Reproductive concerns tend to be an accumulation of errors (Dr. Brad White, personal communication), and solving these concerns is rewarding for both the herd owner and the veterinarian. Utilizing the techniques discussed in this paper should provide a template to preventing and/or solving reproductive concerns in a beef herd.

Heifers

Selection

Building a beef herd that excels in fertility should start with the selection of heifer calves that will breed early, calve yearly on schedule, and remain in the herd for 12 to 15 years. Since reproductive traits tend to be of low heritability^{4,18,19} (10% or lower) selection for 'fertility' cannot be the primary focus of ensuring reproductive success.

Heifers selected as potential replacements need to be able to thrive in their given environment. If a highly fertile, low-maintenance herd is desired, females with excessive nutrient demands will not allow the herd to reach its goals. Extreme milk production, mature body weight, and frame score must not compromise the overall goal of having a herd that excels in fertility, as extremes in any or all can diminish herd fertility.

Recent work from Australia indicates that Angus heifers selected for low residual feed intake (RFI) calved 8.1 days later than high RFI females across two calving seasons.⁸ Conversely, some other studies with similar parameters have shown no difference in fertility among females of differing RFI. While low RFI will improve the efficiency of our industry, we must be cautious not to use single-trait selection and suffer some unintended consequences.

Economics

Reproductive efficiency is about optimums and not maximums. The law of diminishing marginal returns states that “in all productive processes, adding more of one factor of production, while holding all others constant, will at some point yield lower per-unit returns” (Wikipedia). Adding more costs, e.g. generally feed, to the *group* to get one or more or even all the heifers pregnant is generally not cost-effective when the initial pregnancy rate is already quite acceptable.

Recommended guidelines for heifer development have generally been to target a weight of 60 – 65% of mature body weight at the time of breeding. Recent work from Nebraska that targeted heifers to weigh 55 – 60% of mature body weight at breeding showed a feed cost savings of \$22 per heifer when heifers were bred at 53 vs. 58% of mature body weight.¹⁰ Developing spring-born heifers to calve at 53% of mature body weight did not affect reproductive success, dystocia rate or calf performance compared to heifers at 58% of mature body weight. We must be aware, though, that targets are not always met, as was the case in this study. Heifers developed to weigh 53% of mature weight may in fact reach a weight below this target and cause reproductive rate to fall below an acceptable rate. Leaving some room for error seems to be a prudent tactic.

Heifers can be developed to gain steadily from weaning to breeding, or the growth rate can be variable across this time frame. The path to puberty is unimportant so long as the heifer attains puberty before breeding.^{9,17,21,23}

Records from the American Angus Association in 2008 showed that the average six to seven-year-old cow weighed 1384 lb (629 kg),²⁰ so a heifer in this “average” herd needs to weigh 734 to 900 lb (334 to 409 kg) at breeding if she is to weigh 53-65% of her mature body weight. While 1,384 lb is the average weight of a registered Angus cow, this figure can be highly variable across herds in North America. For our example, we will use this weight as the mature weight of the cows.

If a heifer born on March 23 is weaned 190 days later on September 19 and weighs 475 lb (216 kg), a gain of 324 lb (147 kg) is needed to reach the target breeding weight of 800 lb (364 kg) - used 59% for example - by May 23 of the following year. This will give a calving date

of March 1 the following year, which equates to calving at approximately 23 months of age. To gain 325 lb (148 kg) over 246 days, a gain of 1.32 lb (0.60 kg) per day is necessary. An example ration of 16 lb of hay and 4 lb of dry corn gluten with appropriate vitamins and minerals would cost \$1.15 per head per day. A more cost-effective option would be to allow a 30-day backgrounding ration, where heifers gain 1.5 lb (0.68 kg) per day and then have 60 days of grazing cornstalks (cost \$0.00 – 3.60 for 60 days) or stockpiled grass (\$21.00 for 60 days) where heifers might gain 0-30 lb in 60 days.²² After this, the heifers have 155 days to gain 280 lb (127 kg), and a growing ration containing a higher percentage of a co-product feed like corn gluten feed or distiller’s grains with solubles would be a reasonable choice that would also cost less than the \$1.15 per day ration.

Crossbreeding

The major benefit of heterosis is in strengthening lowly heritable traits.^{6,18} In a commercial herd all potential replacement heifers should be crossbreeds, with no more than 75% of one breed making up the cross. Research at Montana State University showed that crossbred cows had 1.2 years longer productive lives and weaned 74 lb (34 kg) more calf per cow exposed each year compared to the straightbred cows. The financial benefit was nearly \$70 per cow per year for the crossbred cows compared to their straightbred counterparts.⁷

Breed Heifers Early

In most beef herds, getting nursing two-year-olds bred back is the biggest fertility challenge. As we examine herd nutrient needs, this female is still growing and requires additional energy and protein compared to a mature cow.⁵ One technique is to breed heifers two to three weeks before the cow herd so that this high-risk group has additional days from calving to rebreeding. At times the environmental stress that could be associated with earlier calving is not worth the benefit of the increased lag time before breeding, so this needs to be addressed before this recommendation is made.

Shortened Breeding Season for Heifers

A late calving heifer becomes a late calving cow or an open cow.^{3,8,16,28} The way to keep this negative from happening is to not allow any heifers to calve late. If the cow breeding season is 65 days, the heifer season should be only 40 to 45 days. If the adult cows calve March 21 to May 25 and the heifers calve March 1 to April 11 (21 days ahead of cows and for only 40 days), even the last heifer to calve is exposed to the bulls from day 62 to 127 post-calving, which should give the heifer

an excellent chance to rebreed (Figure 1). If, however, a heifer calves on May 25, she is only exposed to the bull from day 18 to 82 post calving! This will likely give her only one opportunity for rebreeding. Do not start with a problem! Breed heifers for a shorter time than cows. Exposing about 10% more heifers to the bull should produce a similar number of pregnant heifers if breeding is reduced from 65 to 40 days.

Pregnancy Exam Heifers Early

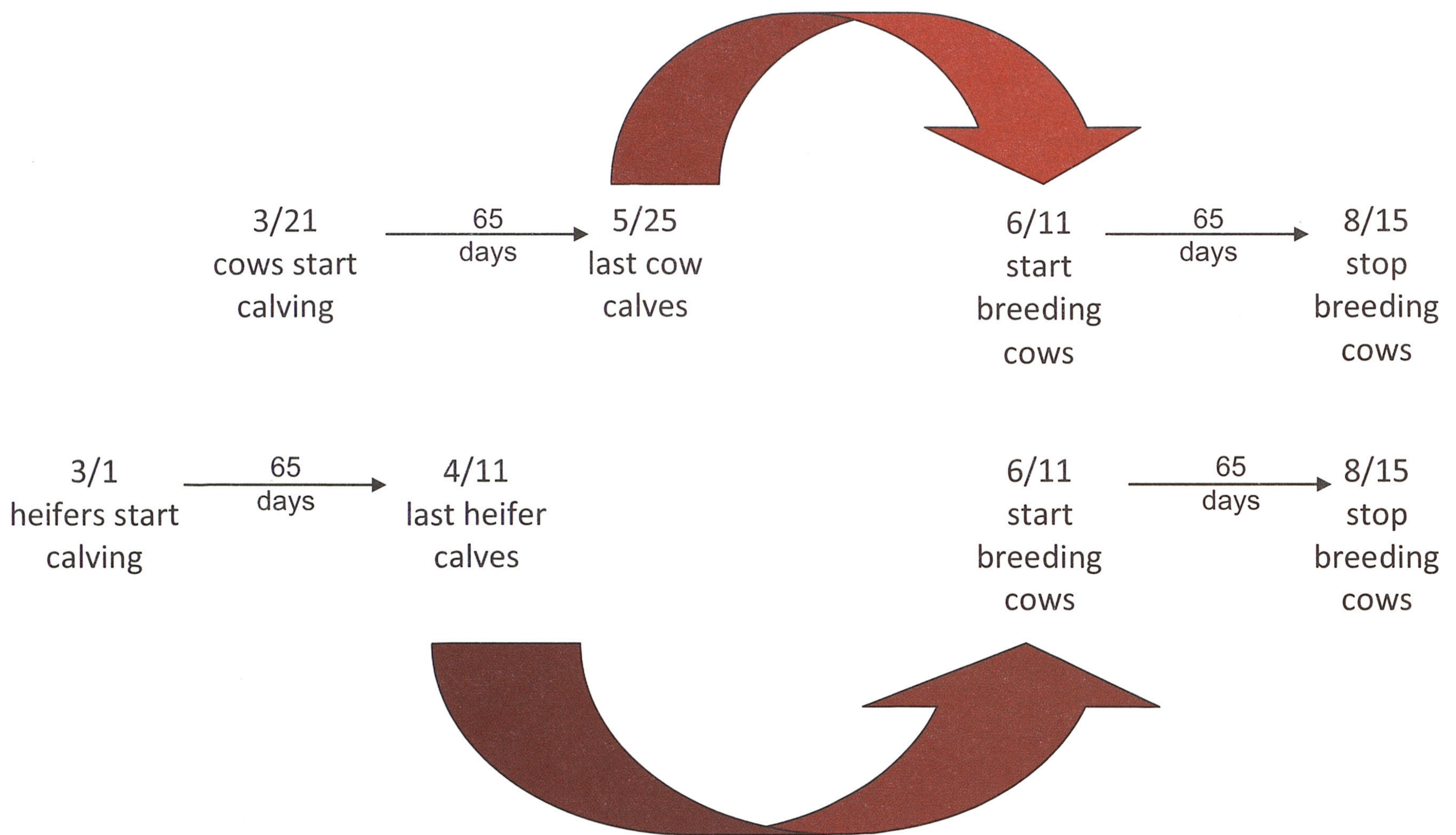
Another advantage to breeding heifers for a reduced time is that these heifers can be pregnancy checked early so that all open heifers can move to the feedlot. If heifer breeding is from May 22 to July 01, they can be examined for pregnancy around August

10. In the Midwest our pastures are in the “summer slump”, and a non-productive animal is better to be off the pasture and in the feedlot.

The economics of having a heifer at 16 months of age and open is somewhat surprisingly favorable for the owner’s beef business, as shown in Table 1.

Herd Health

Every herd owner needs a herd-health veterinarian to guide them on health decisions. A proper vaccination protocol melded with a biosecurity and parasite control program is a must. This veterinarian must also be knowledgeable in areas of nutrition or work with a nutrition consultant, as this is a key component of a healthy herd.



From 3/21 to 6/11, first cow has 82 days “lag” from calving to start of breeding
 From 5/25 to 6/11, last cow has 18 days “lag” from calving to start of breeding

From 3/1 to 6/11, first heifer has 103 days “lag” from calving to start of breeding
 From 4/11 to 6/11, last heifer has 62 days “lag” from calving to start of breeding

Figure 1. Breeding heifers before cows.

Table 1. Price comparison of bred vs open heifer at pregnancy check.

		Weight (lb)	Price/cwt	Bred	Open
Heifer value					
at weaning		500	\$ 137.00	\$ 685.00	\$ 685.00
9/1/2011					
at preg check		950	\$ 110.00	\$ 1,045.00 ?	\$ 1,045.00
7/19/2011					
		Days fed	Cost/day	Total cost	
Cost to feed/					
develop 3 mo.	pasture	90	\$ 0.55	\$ 49.50	
	feedlot	90	\$ 3.54		\$ 318.60
		Weight (lb)	Price/cwt	Value	
Heifer value					
on 10/19/2011	pasture	1050	-----	\$ 1,200.00	
	feedlot	1300	\$ 118.00		\$ 1,534.00
Added value				\$ 105.50	\$ 170.40
3 months					

Nutrition

Priority of Energy Use by the Cow

Reproduction is a luxury to all animals, and females must intake enough energy or have enough energy reserves to initiate cyclicity. According to Short *et al*, a cow needs to meet each of these needs before the next one is met:²⁴

1. Basal metabolism
2. Physical activities – including grazing
3. Growth
4. Supporting basic energy reserves
5. Maintaining an existing pregnancy
6. Milk production
7. Adding to energy reserves
8. Estrous cycling and initiating pregnancy
9. Storing excess energy

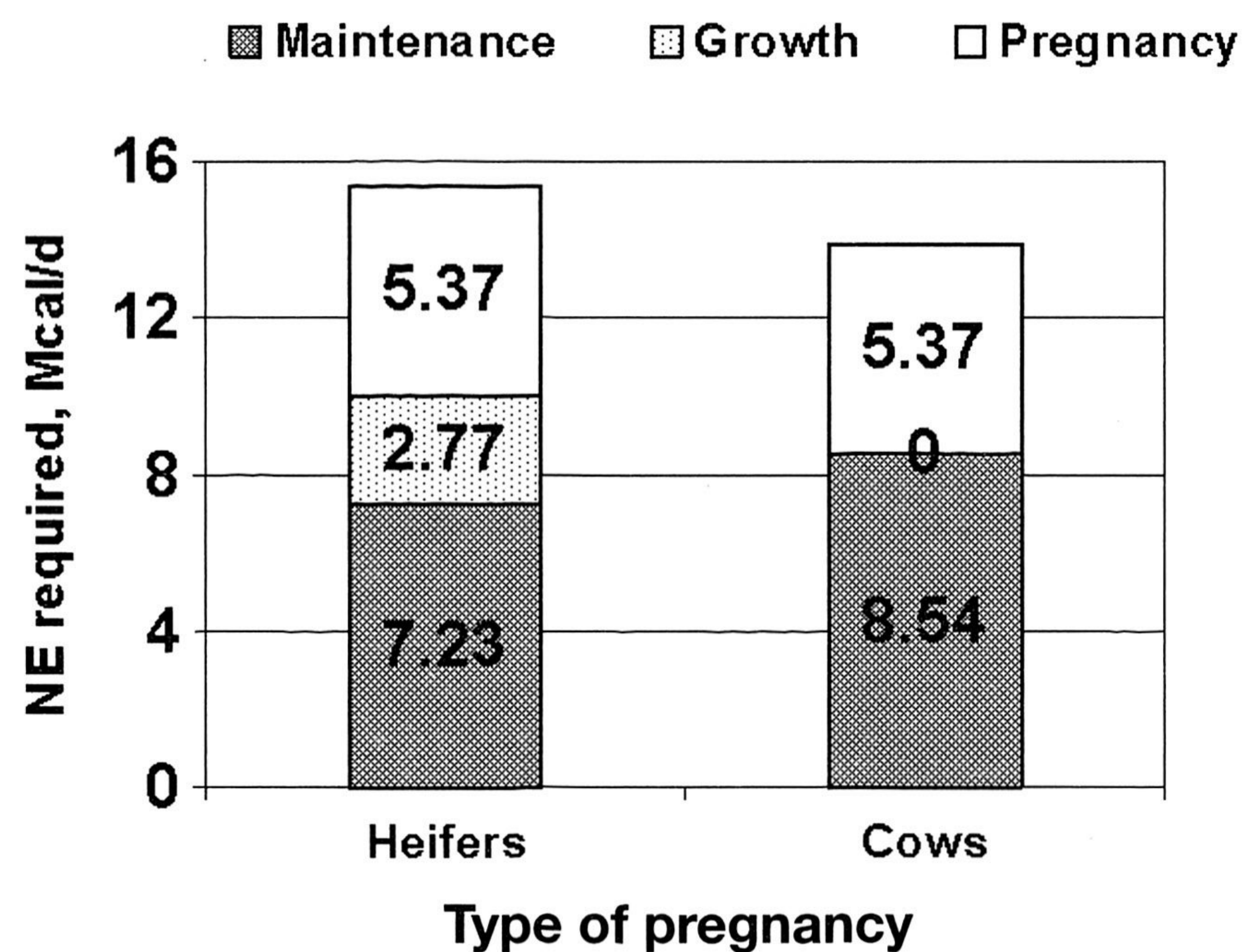
The list makes it very apparent that estrous cycling and initiating a pregnancy is not a high priority to the cow, and adequate nutrition must be supplied if the cow is going to maintain a yearly calving interval (Table 2).

Body Condition Score

Body Condition Score (BCS) at calving is the single most important factor in rebreeding success.¹⁰ Since heifers have an increased requirement for energy and protein compared to mature cows, heifers should calve in a BCS greater than cows.⁵ Most studies show a BCS of 5.5 to 6.0 out of 9 is optimum for cows,^{14,15} so heifers should calve in BCS 6.5 to 7.0. This is especially true with the increased mature size and increased milk

production of today's females. A study done from 1985-1987²⁵ showed that a BCS of 6.0 at calving was superior to BCS of 5.0 or 4.0 in terms of rebreeding success (96 vs. 80 vs. 56) in a 60-day breeding season. The heifers in the study weighed 933 lb (424 kg) for BCS 6.0 and 744 lb (338 kg) for BCS 4.0, so they were significantly lighter than a typical two-year-old today. In addition,

Table 2. Energy requirements during the last month of gestation in cow.⁵ (Caton JS, *et al*: Nutritional management during gestation: impacts on lifelong performance. *Proceedings of the Florida Ruminant Nutrition Symposium*, Gainesville, FL, January 2007. Used with permission.)



the average Expected Progeny Difference (EPD) for milk in the Angus breed was +2 in 1986 and in 2011 it is +21. (www.angus.org) Other breeds have seen similar increases in milk production, and increased milk production demands increased energy intake and increased precalving BCS.

The most cost-effective time to add BCS to a cow is in the period immediately post-weaning. If cows are thin at weaning time and calves are weaned at seven months of age or older, cows have little chance to regain BCS before the next calving season. This factor is compounded if the cows are under environmental stress during this time. If a cow that calves in March has her calf weaned in November in the northern half of North America, adding BCS from November to March is nearly impossible or very expensive. If these same calves are weaned in September at 5.5 to 6 months of age, herd fertility will ultimately be improved because cows go into the winter and calve in a higher BCS. Herd profitability will also increase, as it is cheaper to feed the calf directly than to feed the cow to feed the calf (Table 3).

In seven of nine trials where high-energy rations were compared to moderate and low-energy rations, dystocia rate was unchanged even though birth weights were altered in some experiments. In four of the five trials where protein levels were varied, high-protein rations again did not increase dystocia rates. It appears that heifers need to calve in a BCS of >7 to decrease fertility and increase dystocia rates.¹²

While BCS at calving has the highest correlation to rebreeding success, heifers and cows must be fed a balanced ration post-calving if cows are expected to become pregnant in a timely manner.

Micronutrient Nutrition

Numerous studies have looked at the role of micronutrient deficiencies on herd reproductive status. While the roles of copper, selenium, manganese, Vitamin A, and Vitamin E have been studied in herd reproductive problems, the results have been inconsistent. Recently a study of 771 cows in 39 herds in western Canada showed a significant ($P<0.001$) association between serum copper concentrations and pregnancy status in cows less than 10 years of age. The strongest association with non-pregnancy was for cows with serum copper concentrations less than 0.40 ppm.²⁷

Remedies for an Extended Calving Season

Even utilizing the recommendations for producing fertile, early-calving heifers, herds with an extended calving season will need to either add a secondary calving season to the herd management plan or cut days from the singular breeding season each year and cull all open cows. It is unrealistic to assume a producer can move from a 180-day calving season, where 25% of the calves are born in the first 21 days of the calving season, to a 65-day season in one year.

If a herd is located in an area where two separate calving seasons are environmentally sustainable, this is an easy and quick fix to an extended calving season. For example, if a herd currently calves year around and a March 1 to May 5 season is ideal, with a secondary season of September 1 to October 31 also acceptable, this extended season can be remedied in just over a year by timely pulling of the bulls, pregnancy testing cows, and culling all opens. I have developed a spreadsheet for use

Table 3. Relationship of body condition score (BCS) to beef cow performance and income.^a

BCS ^b	Preg rate % ^c	Calving interval, days	Wean age, days ^d	Calf ADG ^e (lb)	Calf WW ^f (lb)	Calf value, \$/cwt ^g	Gross income ^h	Cow income ⁱ
3	43	414	190	1.60	374	125	468	185
4	61	381	223	1.75	460	120	552	310
5	86	364	240	1.85	514	116	596	471
6	93	364	240	1.85	514	116	596	510

^aAdapted from Kunkle *et al.*, 1998 UF/IFAS Publication SP-144.

^bBody Condition Score: scale of 1 (thin) to 9 (obese).

^cPregnancy rates averaged across trials in Texas, Oklahoma, and Florida when BCS was assessed at calving, breeding, and pregnancy testing.

^dWeaning Age; 240 days for cows in BCS of 5 and 6 and decreases as calving intervals increase.

^eAverage Daily Gain

^fAdjusted Weaning Weight; calculated as calf age times calf gain plus birth weight (70 lb).

^gAverage price for similar weight calves during December of 2010.

^hCalculated as calf weight times calf price.

ⁱCalculated as income/calf times pregnancy rate times 0.92 (% calves raised as those pregnant).

in the timing of various events and it can be downloaded from www.mwbeefcattle.com.

If the herd has only one time of year that is conducive to calving, the following strategies can be used:

- Keep significantly more heifers than the normal 8 to 20% replacement rate
- Select, develop, and breed heifers as outlined earlier
- Cut 30 to 60 days off the breeding season each year until the herd is at the desired calving season. Sell all open cows.
- For this system to work, the owner cannot have 'favorite' cows that are immune from culling.

Bulls

Fertile Bulls

Every bull should have a complete breeding soundness examination (BSE) before being turned out with cows. A spreadsheet has been developed by Dr. Tom Kasari that assesses the cost-effectiveness of performing a BSE on beef bulls before the breeding season. With 475 lb steers valued at \$140.00 per cwt and cost of \$75 for a BSE, the benefit-to-cost ratio for doing a BSE is \$23.55:1. So the producer realizes a gain of \$23.55 for every dollar spent on doing BSEs on his bulls.

Numerous charts are available for producers to use when determining how many cows a fertile bull can service in a 65-day breeding season. While helpful, the numbers are difficult to remember. We developed a rule of thumb in our practice over 20 years ago that recommends that a bull be placed with one cow per month of age of the bull up to 50. So, a 38-month-old bull should be able to service 38 cows in a 65-day breeding season. Multiple bulls of similar age would also fit our criteria, so three bulls with ages of 25, 28, and 29 months would be able to service 82 cows in a 65-day breeding season.

There are breed differences in regard to fertility, and these need to be taken into consideration. A published research summary on the use of crossbred or composite sires showed that crossbred *Bos Taurus* x *Bos Taurus* bulls had calves born an average of 10 days earlier than comparable purebred bulls, while *Bos Taurus* x *Bos Indicus* bulls sired calves that were born 7.8 days earlier than the purebred bulls.²⁶

Bull Exposure

Exposing females to a herd bull or surgically altered "teaser" bull 20 to 30 days before the start of the breeding season will induce an earlier estrus as compared to females without bull exposure.^{1,29} If a herd bull is used and females actually get bred before the earliest desired service date, exposed females can be given an injection of prostaglandin the day the bulls are turned out. This will abort any females more than

five days pregnant, and most should recycle soon after the injection.

Additional Reproductive Aids

Reproductive tract scoring: In herds with poorer than anticipated pregnancy rates in yearling heifers, the use of reproductive tract scoring (RTS) can be beneficial. Heifers should be palpated 30 to 60 days before the anticipated breeding season so that if a larger than expected number of heifers are found to be in scores 1 to 3, appropriate management changes can be addressed so a majority of heifers are at RTS 4 to 5 at the time of breeding.^{2,13}

Reduced suckling: Twice daily nursing and 48-hour calf removal are both short-term fixes to a potentially long-term problem. Each has been used to salvage a breeding season, but should not become standard procedure (see "heifers, selection").

Ionophores: Feeding heifers monensin or lasalocid will increase the percent of heifers cycling before and during the breeding season and will decrease the postpartum interval on cows. Only monensin is approved for females after breeding, and five trials confirm that feeding monensin decreases the postpartum interval an average of 18.8 days.¹¹

Induction of estrus with hormones: It is the opinion of the author that "jump starting" heifers to induce them to cycle may be counter-productive. Do we have trials that show that anestrous heifers that were hormonally induced to cycle have equal stayability as compared to heifers that had cycled naturally prior to the breeding season? If these induced heifers have fewer productive years due to lower inherent fertility, we are better served to have them be open as yearlings. Fertility is a lowly heritable trait, but most studies do show some degree of heritability.^{4,18,19}

Conclusions

Assisting a herd owner in achieving reproductive efficiency is a long-term endeavor that will improve herd uniformity, marketing, health, and herd profitability while decreasing labor. If a herd has under-performed with regard to herd fertility a multifaceted, deliberate approach to improving nutrition, genetics, health, record keeping, and herd management is the key to success.

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