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FEED EFFICIENCY IN THE RANGE BEEF COW: WHAT SHOULD WE BE LOOKING AT?

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INTRODUCTION

Beef cow efficiency is a critically important topic for range cow producers. Feed efficiency, or the ability to convert grazed forages into production, is obviously an important aspect of overall cow efficiency. The late Bob Taylor from CSU made the statement "profitable cattle are usually productive, but productive cattle are not always profitable" (Taylor, 1994). That is an inherently important concept in the efficiency discussion, as it leads us to question the important metrics in determining feed efficiency in the cow.

Efficiency must be associated with biological type of cow, not just cow size. Higher milking cows have higher maintenance requirements, even when the cows are not in lactation (Ferrell and Jenkins, 1984). A five-year study evaluated the efficiency of different breeds types supplied varying levels of feed input (dry matter intake) throughout each year (Jenkins and Ferrell, 1994). Larger, higher output type cows (breeds) had a greater weaning weight per pound of feed consumed per cow exposed when in a liberal feed situation than did moderate output breeds. However, when feed supply was restricted, the moderate type breeds had a greater weaning weight per pound of forage consumed per cow exposed than the larger breeds. There are certainly differences within breeds, but the point is that biological type of cow is important in terms of their production across varying feed supplies. Note that the environment is not necessarily related to a certain part of the country. One Northern Great Plains rancher might strive to run cows on native range with no hay and limited supplement, while another might have the option to winter cows on crop aftermath and ethanol production by-products (at relatively low costs).

Therefore, a rancher must look at the environment and system that cows are running in and evaluate the key metrics of performance in those systems. Patterson and Richards (2007) concluded that a key metric to evaluate is unit cost of production, or the cost to produce a pound of calf. You can lower unit cost of production by increasing output (lbs of calf weaned/cow exposed) or by lowering cost. Other examples of key metrics were listed as:

1) pregnancy rate
2) weaning weight/cow exposed
3) cows bred in the first 21 days of the breeding season
4) cow body condition score in at pregnancy testing

5) harvested/purchased feed costs
So, we know that biological type affects efficiency and that interacts with the environment and system that animals run in. That may start to form some foundation to some genetic decisions on a particular cow herd. For Padlock Ranch, we put emphasis on moderate milk and also a more moderate biological type. We are also interested in the performance of the calves, because at the end of the day you have a product to sell. What complicates these decisions is all of the factors involved, including genetics, environment, cattle management, range management, cost structures, and marketing plans. Do we just throw up our hands and say this is an unsolvable puzzle? I do not think so. The above mentioned considerations are important to understand and incorporate, but one approach is to start narrowing down on some high leverage areas. Having adequate reproduction in the system that you are running in is paramount to beef cow efficiency. We will take a look at the importance of reproduction and the potential for leverage in developing the young cow. This paper is not a comprehensive review of all the factors involved in range beef cow feed efficiency and overall cow efficiency. I want to point out a few strategic areas that we believe are important and areas where more work and knowledge are needed. The focus of this discussion is thus on some unique aspects of heifer and young cow reproduction and the systems that lead to improved longevity.

ECONOMICS OF REPRODUCITON AND LONGEVITY

Working with data from a large commercial operation, Meek et al. (1999) estimated the net present value (NPV) of cows of various ages. An NPV value gives an estimation of net cash flow (revenue from calves and cull cows) less the expenses beginning in a particular year throughout the productive life of a set of cows. This value is discounted to account for the time value of money. So, if you start with 100 bred heifers and have an 80% pregnancy rate on two-year olds with no culls, there would be 80 three-year-old cows the next year and so on. What researchers found was that the NPV of young cows (one to three years) was less than that of four and five year old cows. Why would that be, since a young cow would be expected to have more production potential? Lower reproduction in young cows is a driver in this calculation. Other factors include costs, marketing of calves from young cows, and open cow marketing. We will focus on the reproductive aspect in this discussion. The point is that in many systems, failed reproduction in young cows lowers their NPV and thus lifetime profit potential of the cows. The study also determined that for this operation to achieve a 1% increase in two-year-old pregnancy, you could afford to pay \$2.68/head before the first breeding (during replacement heifer development) or \$5.67 after she was bred (as a bred heifer). Do you think you would be more likely to increase two-year-old pregnancy by spending \$2.68 prior to first breeding or \$5.67 on the bred heifer? I believe the latter would be more achievable.

Using this same approach, I modeled the NPV of a set of 100 bred, coming two-year-old cows using two reproductive scenarios (Table 1). In scenario 1, I assumed two and three year old pregnancy rates at 88%. I assumed running age cows had a pregnancy rate of 93% with that tapering off at age 11 and all remaining cows culled at age 13 (not many left by that age; see Table 1). I used 5-yr average 550 lb calf prices and cull cows prices. I then calculated the NPV of the two-year-old. In the second scenario, I used 75% for the pregnancy rate on two and three-year-old cows. That is all I changed. It changed the average age of the set of cows over their lifetime from 5.6 years in scenario 1 (88% young cow pregnancy rate) to 5.3 years in scenario 2 (75% young cow pregnancy rate). The absolute values are not what are important, as that varies with the assumptions on markets and preg/cull rates on the base cow herd. What is important is the relationship. The cows in scenario 1 had an NPV of $1821/hd vs $1611/hd in scenario 2. So, the modest change of 0.3 years average cow age affected by young cow reproduction changed the life-time value of the cows by $210/hd. That has direct implications to the bottom line of a ranching business. Young cow reproduction is important. Zietsman (2014) looked at efficiency as a cow having its second calf by the age of three years old. This is a high leverage area!

MANAGEMENT SYSTEMS AND HEIFER DEVELOPMENT

What factors might affect the efficiency of a young animal to convert feed into reproductive performance? One potential factor is in the development of the heifer. For Padlock Ranch, we have noticed our cost to put a bred heifer in the herd has increased from $830/hd in 2007 to $1053/hd in 2013. The default heifer development program for Padlock is for heifers to be developed in the feedlot, run on irrigated pasture with cell grazing in early summer, and graze native range post-AI to pregnancy testing. In order to reduce costs, we have been looking at developing these heifers on native range during the winter. These range-developed heifers do not gain what their feedlot-developed counter parts gain during the winter, but they compensate a portion of that weight difference in early summer if the feed is available and pasture management is good (we breed for May calving).

If the summer is dry or pasture management is not good, you can have some reduction in first-service conception. This was our experience in 2009 when range-developed heifers had a 10% lower conception rate than their feedlot-developed counterparts. That was a dry year and we did not make the best pasture choices for those heifers in early summer (they were not managed on as good of feed and water as could have been allocated to them). In 2011, we had 500 range-developed heifers and 1,000 feedlot-developed heifers. The range-developed heifers received no hay and were fed 3 lbs of protein cake during the winter. They weighed 771 lbs at breeding in July compared to the feedlot developed heifers that weighed 879 lbs. First service conception rates were 60.9% and 61.6% for range and feedlot developed heifers, respectively. In 2012, we had 1,000 range developed heifers and 1,600 feedlot developed heifers. The range-developed heifers received no hay and 2 lbs of protein cake during the winter. The range-developed heifers weighed 865 lbs at breeding and had a 64.5% first service conception, compared to the feedlot heifers that weighed 913 lbs with a 60.7% first service conception. We will be tracking these cattle over time to look at influences on longevity. In recent years, we have observed reproduction in two-year-old cows at similar rates as the mature cow herd.

We want to know, and we need more data to confirm, as to whether we are building a better cow by range development since we are asking our mature cows to perform with little harvested feed during the winter. Working in northern South Dakota, Salverson et al. (2005) found that heifers wintered on range with a distillers grains supplement (2-7 lbs/day for a target 1.5 lb/day gain) gained 2.1 lbs/day from May 18 to time of AI on June 14. This compared to heifers developed in a dry lot on grass hay and wheat-midd based supplement having pasture gains during that period of time of 0.32 lb/day. No supplement was given after May 18. Since the dry lot and range heifers were supplemented to have similar winter gains, that difference could not be contributed to compensatory gain. Also, with the dry lot heifers on a grass hay and modest amount of supplement (3.5 lbs/day), it is not expected it was due to marked differences in rumen microbial adaptation. Perry et al. (2013), in a five-year study, evaluated the performance of heifers with grazing experience prior to AI to those that were developed and remained in a dry lot until after AI. In three of the years heifers wintered out on range or were developed in a dry lot as described above in Salverson et al. (2005), except the dry lot heifers remained confined until after AI. In two years of the study, all heifers were wintered in the dry lot but ½ of the heifers were turned out to grass 30 days prior to AI whereas the dry lot heifers stayed in the dry lot until after AI. Across all 5 years, researchers found that heifers that had grazing experience prior to AI had an average daily gain of 1.28 lb/day between AI and pregnancy detection (30-70 d post AI) compared to an ADG of 0.46 lbs/day for heifers that did not have experience grazing prior to AI ($P < 0.01$). Also, pregnancy to AI was higher ($P = 0.04$) for heifers with pre-breeding grazing experience (59.4%) compared to those without grazing experience prior to breeding (49.1%). The authors hypothesized that learned grazing behavior was important in the conversion of feed resources to gain and reproductive success. Others work has showed that learned grazing behavior does indeed exist (Provenza and Balph, 1988). One important question we have at Padlock Ranch is whether we want cows experiencing their first winter grazing as a bred heifer or a bred two-year-old cow? We believe we can achieve more economic success by allowing heifers to experience this for the first time as a heifer calf. Grazing behavior may be an important aspect of efficiency.

Work in Fort Keogh in Miles City, MT showed that progeny from cows that were managed on a marginal level of nutrition during the winter were heaver at age five than cows that were managed on an adequate level of nutrition (Roberts et al., 2011). The authors contributed this to those cows being in a higher level of body condition. This brings into question what affects the nutrition and management of the dam can have on her subsequent offspring. For instance, it is possible that keeping replacements out of cows or heifers that have been managed with more abundant feed during gestation might affect that animals' ability to hold condition in more restricted feed situations.

Does that mean that if you skimp on the cow nutrition during gestation that the heifer progeny would be better? I do not interpret it that way. That study was looking at systems of management. Summers and Funston (2013) concluded that maternal nutrition during gestation can influence adequate nutrient transfer to the fetus, fetal organ development, muscle development, postnatal calf performance, carcass characteristics, and reproduction. That paper cited the work of Martin et al (2007) that showed heifer progeny from cows that were supplemented protein during gestation had higher pregnancy rates (93 vs 80 for supplemented and non-supplemented dams, respectively; $P \leq 0.05$). There was a trend ($P = 0.13$) for higher pregnancy rates in a second study (90 vs 83 for supplemented and non-supplemented dams, respectively; Funston et al. 2010). Fetal programming may be an important aspect of efficiency that can affect reproduction in young females.

CONCLUSION

The topic of feed efficiency in range cows is complicated and has genetic, management, and environmental components. Reproduction in the young cattle as it relates to longevity is important to overall economic efficiency in the cow herd and is a high leverage point. The management of the heifer calf as it relates to training them for grazing can affect grazing behavior early in life. Extensive development systems with proper management can reduce costs and result in adequate reproduction. More work is needed to determine the long-term effects of such strategies on the cow herd. Fetal programming may also be an important factor in determining reproductive efficiency of young animals, and thus can be an important factor in how efficiently animals convert the feed resources into reproductive success. Can we build a more efficient cow through management? Research indicates that the potential is certainly there.

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TABLE

Table 1. Cows and pregnancy rates used in a net present value model for two longevity scenarios.

	Avg Age 5.6 years		Avg Age 5.3 Years	
Age	**# Cows**	**Preg %**	**# Cows**	**Preg %**
2	**100**	**88**	**100**	**75**
3	**86**	**88**	**73**	**75**
4	**71**	**93**	**51**	**93**
5	**62**	**93**	**44**	**93**
6	**54**	**93**	**39**	**93**
7	**47**	**93**	**34**	**93**
8	**41**	**93**	**29**	**93**
9	**36**	**93**	**25**	**93**
10	**31**	**93**	**22**	**93**
11	**25**	**90**	**18**	**90**
12	**19**	**85**	**14**	**85**
13	**7**	**80**	**5**	**80**

NOTES