EFFECT OF HEIFER CALVING DATE ON LONGEVITY AND LIFETIME PRODUCTIVITY

E.M. Mousel[1], R.A. Cushman[2], G.A. Perry[3], and L.K. Kill[3]
[1]Department of Agricultural Sciences, Northwest Missouri State University, Maryville, MO
[2]Reproduction Research Unit, USDA-ARS, U.S. Meat Animal Research Center, Clay Center, NE
[3]Department of Animal Science, South Dakota State University, Brookings, SD

Introduction

Longevity and lifetime productivity are important factors in profitability of the beef cow herd. Therefore, a concern for many producers is the productivity and longevity of the individual cow in their herd. The 2007-08 survey from National Animal Health Monitoring System (NAHMS) reported that the largest percentages of cows (33%) are culled because they do not become pregnant during the breeding season. It also reported that 15.6% of all culled cows leave the herd before 5 years of age, and an additional 31.8% leave the herd between 5 and 9 years of age. Research has reported that it takes 5 calves to pay for the development costs and annual maintenance of a replacement heifer (E.M. Mousel, Unpublished data). Therefore, to be sustainable, producers need to manage their herd to reduce the number of cows that are culled at a young age.

One such management practice is to ensure heifers conceive in their first breeding season. According to research by Patterson et al., (1992) heifers that calve prior to 24 months of age have increased lifetime productivity compared to heifers that calve after 24 months of age. Additionally, if heifers breed early in their first breeding season they will calve early in the calving season and have a longer post-partum interval, which should increase their chance of rebreeding and continually calving early. This management practice is not only beneficial to the dams, but also the calves. Heifers born in the first part of the calving season have been reported to have heavier weaning weights; more had reached puberty prior to the breeding season; and had greater pregnancy success. Steers born early in the calving season had heavier hot carcass weights and greater carcass values (Larson and Funston, 2009; Funston et al., 2011). Therefore, the objective of this study was to determine the effect of a heifer calving date on longevity and lifetime productivity.

Materials and Methods

Data Populations. Two separate populations were evaluated in this study. The first population included data collected from producers involved in South Dakota Integrated Resource Management groups. The second population included heifers and their respective calves over a twenty-one year period of time (1980 to 2000) at the USMARC. Each population was then limited to only heifers that had conceived through natural service during their first breeding season. This left the first population to include 2,195 heifers and the second population to include 16,469 heifers. These heifers were then sorted into 21 day calving groups. The first breeding season that a heifer was recorded as open, they were considered culled for reproductive reasons, which ended their longevity and lifetime productivity. Heifers that were removed from the herd, yet still recorded as pregnant were censored from the data analysis the year they left the herd.

Statistical Analysis. Influence of calving group on longevity within each population was determined using survival analysis (PROC LIFETEST) in SAS. The impact of calving group on weaning weight was determined using the general linear model (PROC GLM) in SAS. The model included the effects of calving group, herd, year, calving group by year, and calving group by herd.

Results

Longevity. Heifers that calved with their first calf during the first 21 d period of the calving season had increased ($P < 0.01$) longevity compared to heifers that calved in the second 21 d period, or later (Figure 1 and 2). There are numerous differences in the circumstances surrounding these two heifer data sets. Most notably is the accumulation of data from South Dakota heifers that encompasses a variety of heifer selection criteria, heifer development programs, and overall reproductive management from multiple cow-calf operations. Conversely, the data from the USMARC represents heifer reproduction data under a common management program.

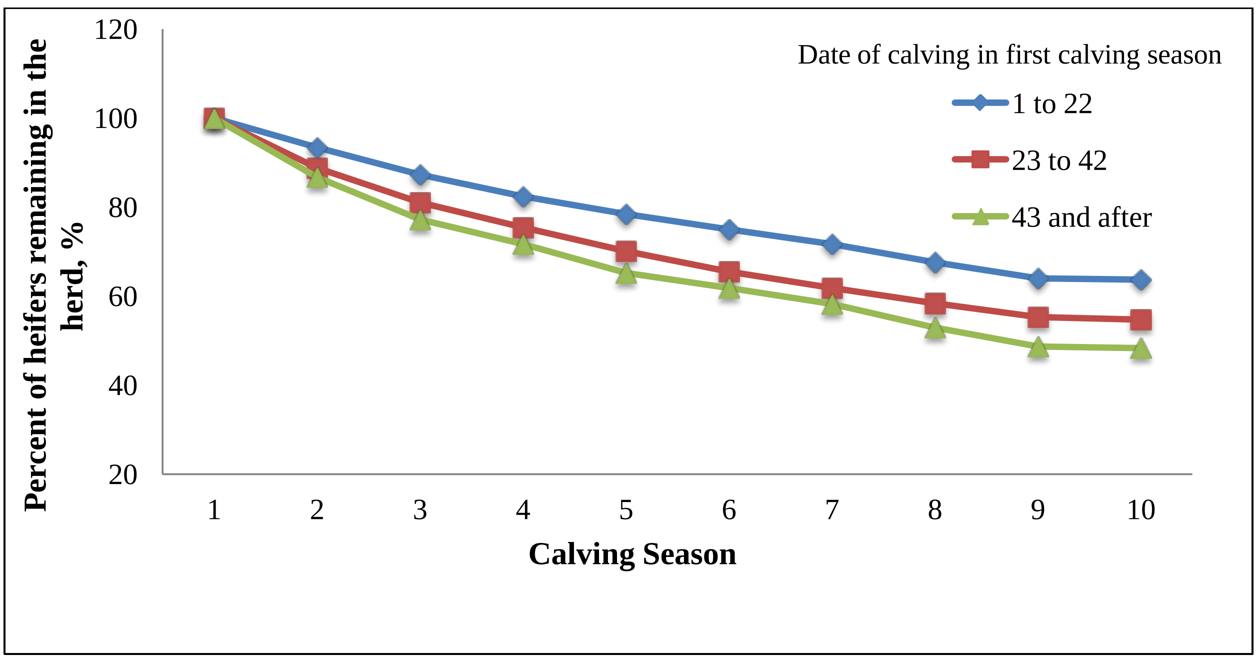

Figure 1. Influence of calving date in first calving season on longevity within the USMARC heifers (P<0.01).

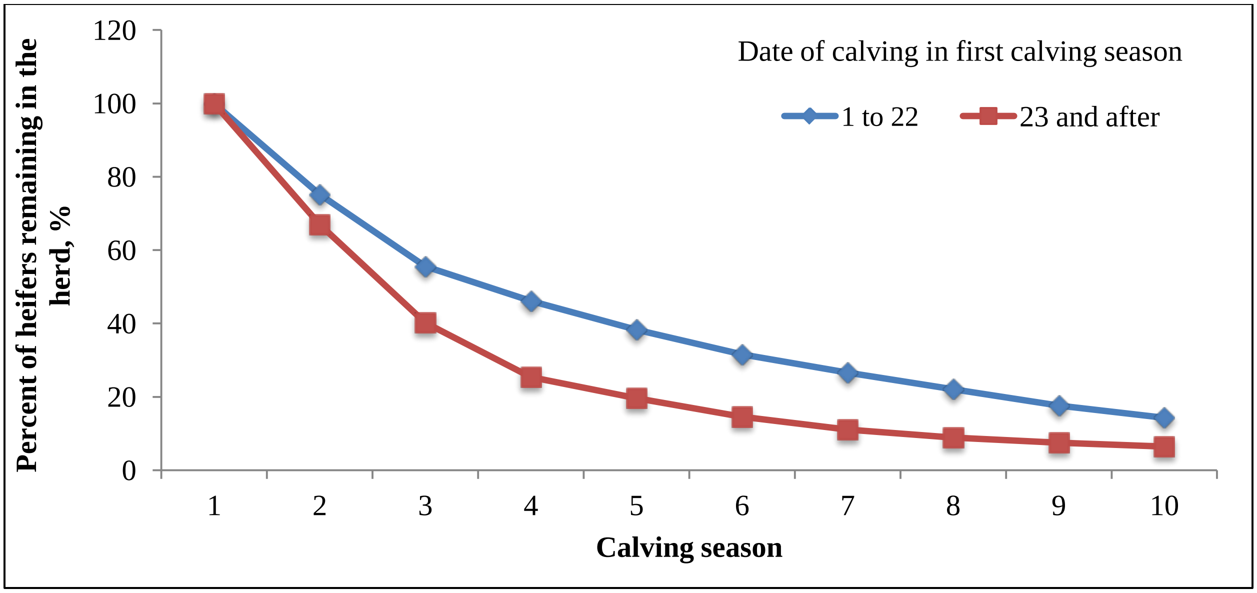

Figure 2. Influence of first calving date in first calving season on longevity within the South Dakota heifers (P<0.01)

Although the objective of this investigation was not to directly compare the two data sets, it is worth noting that the percentage of heifers remaining in the herd varied greatly between heifers evaluated at the USMARC and commercial heifers in South Dakota. Of the heifers that calved with their first calf in the first 21 d period of the calving season at the USMARC, 63.7% of them were still in the herd after 10 calving seasons while only 14.3% of South Dakota heifers remained after 10 calving seasons. It is not immediately clear why so few South Dakota heifers remained in the herd after 10 calving seasons compared to the USMARC; although differences in breed type, climate between South Dakota and south central Nebraska, selection criteria, heifer development program, nutrition program, and overall management likely contribute heavily. The substantial differences between heifer groups, locations, and management programs in these data sets clearly support the notion that there is a positive relationship between early calving heifers and longevity in the herd.

Additionally, average longevity for USMARC heifers that calved in the 1st, 2nd, and later 21 d period was 8.2 ± 0.3, 7.6 ± 0.5, and 7.2 ± 0.1 yr, respectively (Figure 3). Average longevity for South Dakota heifers that calved in the 1st or later 21 d period was 5.1 ± 0.1 and 3.9 ± 0.1 yr, respectively (Figure 4). Furthermore, longevity of USMARC heifers that calved with their first calf during the first 21 d period of the calving season was 7% greater than heifers that calved with their first calf during the second 21 d period of the calving season; and 12% greater than heifers that calved with their first calf in the third 21 d of the calving season. Similarly, longevity of South Dakota heifers that calved with their first calf during the first 21 d period of the calving season was 24% greater than heifers that calved with their first calf during the second 21 d period of the calving season. Not only does this suggest that there are significant differences in longevity and likely; profitability of replacement heifers based on ability to get pregnant early in the breeding season and thus calve early in the calving season; but also that there can be a tremendous amount of variation in how pronounced the differences are. Therefore, the effect of the ability of first calf heifers to calve early in the calving season on longevity of those heifers in the cowherd may be more pronounced in some heifer groups more than others.

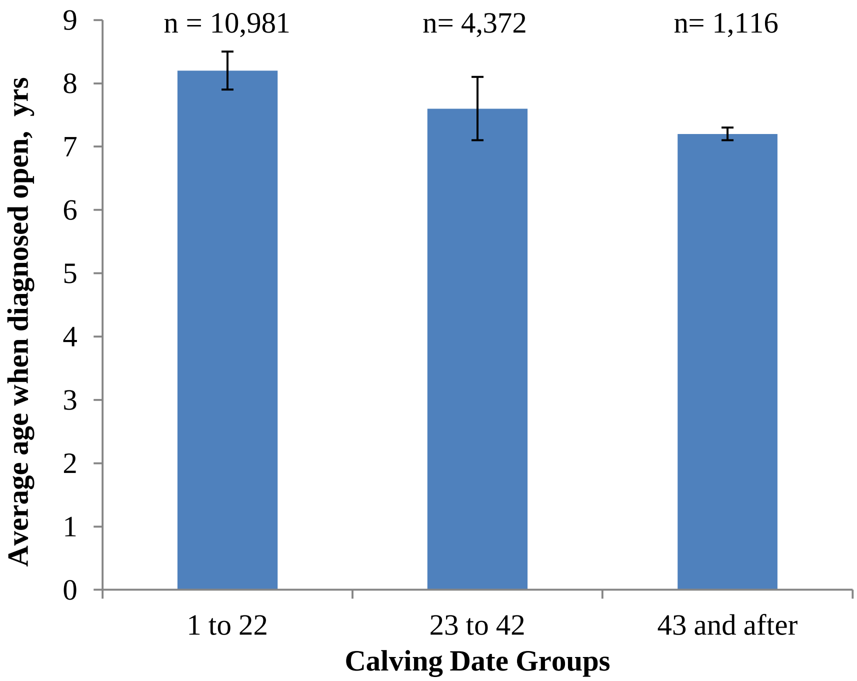

Figure 3. Influence of calving date in first calving season on when heifers were diagnosed open within the USMARC heifers (P<0.01).

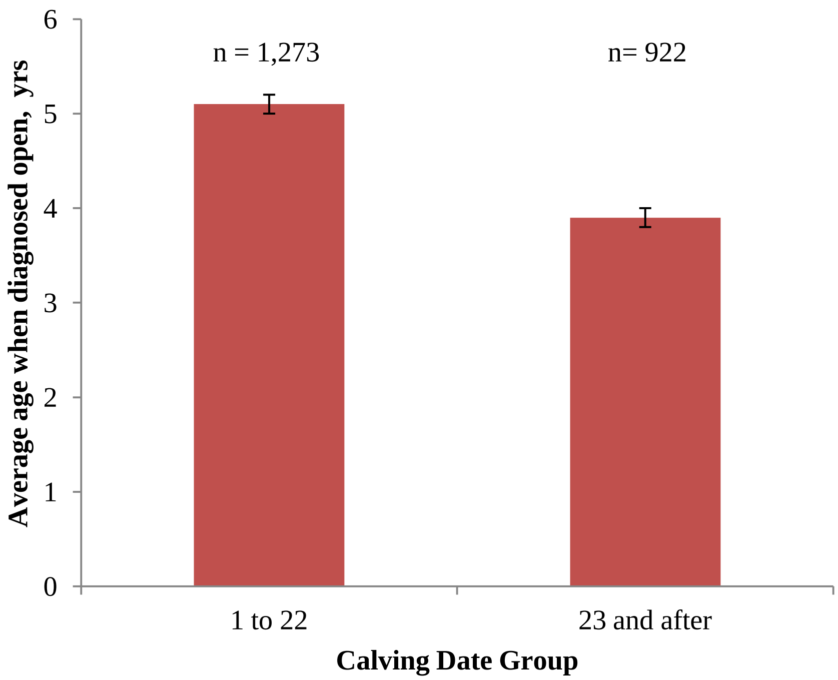

Figure 4. Influence of calving date in first calving season on when heifers were diagnosed open within the South Dakota heifers (P<0.01).

Productivity. Calving period of USMARC heifers influenced ($P \leq 0.03$) weaning weight of the 1^{st}, 2^{nd}, 3^{rd}, 4^{th}, 5^{th}, and 6^{th} calf; but did not influence the weaning weight of the 7^{th} ($P = 0.30$), 8^{th} ($P = 0.30$), or 9^{th} ($P = 0.37$) calf (Figure 5). This test was not performed on South Dakota heifers because no weaning weight data was available. Calving period influenced total kilograms weaned and mean weaning weight ($P < 0.01$), with heifers that calved during the 1^{st} period having increased total kilograms weaned (1,980 ± 11.9 lb) and mean weaning weight (454 ± 0.66 lb) compared to heifers calving in the 2^{nd} or later period, and heifers calving during the 2^{nd} period having increased total kilograms weaned (1,693 ± 18.1 lb) and mean weaning weight (428 ± 1.1 lb) compared to heifers calving later (1,583 ± 35 lb and 384 ± 2.4 lb).

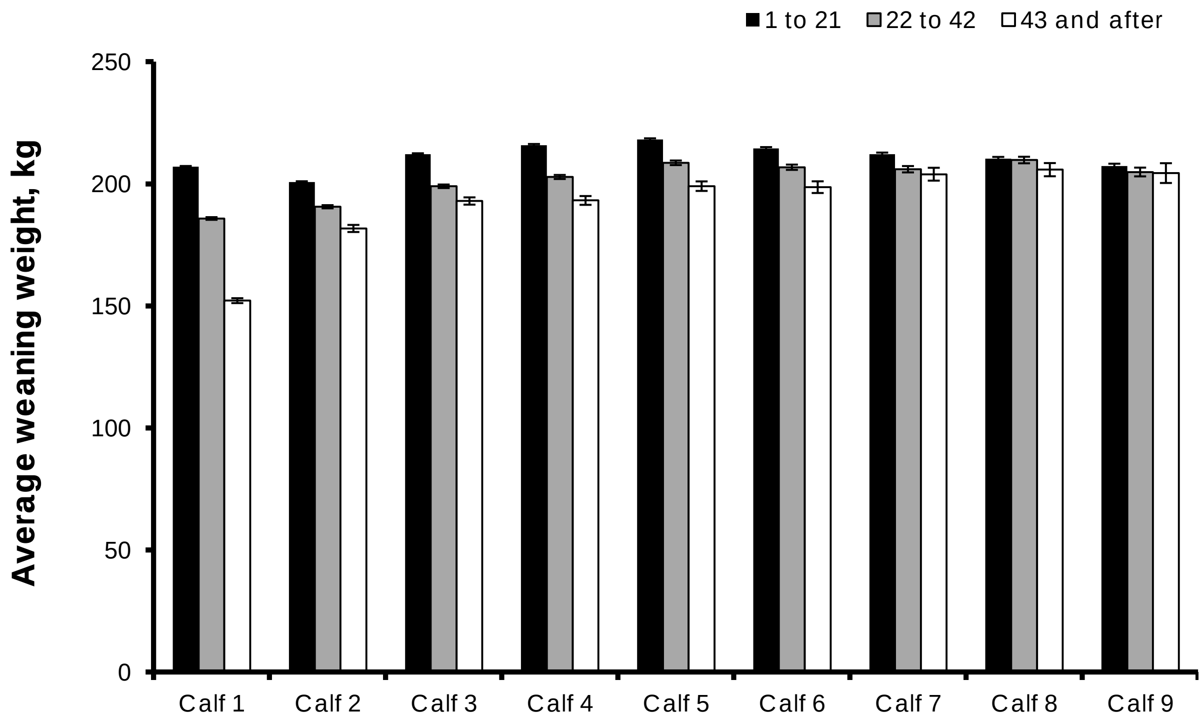

Figure 5. Influence of calving date in first calving season on average weaning weight of calves born to USMARC heifers (*P<0.03).

Shorter postpartum intervals of early calving females play a major role in calf weaning weight in managed beef production systems with a common weaning date; because earlier born calves are older and generally are heavier at time of weaning. There were no differences however, in postpartum interval x 21 d calving period detected in the USMARC heifer groups (data not shown). It is not immediately clear from the data collected in this study how calving period influences weaning weights early in the female's reproductive life but not later in her reproductive life. It is likely that females that have longer reproductive lives wean more calves and thus have a higher lifetime weaning weight average. The higher lifetime weaning weight averages could be more pronounced earlier in the female's lifetime because a higher percentage of her contemporaries that did not have their first calf in the first 21 d of the calving season period drop out of the herd earlier and at a faster rate. Thus the contemporaries would have a lower lifetime weaning weight average. Later in the females life however, lifetime weaning weight average of the contemporary group catches up as their dropout rate declines.

Discussion

Identifying the heifers that calve early in the calving season may be the simplest method to improve longevity and profitability. Many previous studies have shown the relationship between calving early in the calving season and increased longevity in cattle (Deutscher et al. 1991, Patterson et al. 1992, Arthur et al. 1993). Longer postpartum intervals and higher rebreeding rates of early calving females are generally attributed to increased longevity. Consequently, the tendency of cow-calf operators is to select the oldest and largest heifers to improve the chances of them reaching puberty early, breeding early, and calving early in the season. As heavily as this selection criteria is relied upon as a proxy for early puberty in practice; it has had variable results overall. The oldest, heaviest heifers do not always reach puberty the earliest and do not always initiate reproductive cycles the earliest in any given contemporary group; suggesting a tremendous amount of genetic variation, environmental effects, or both. Given the variation in genetics and/or environmental effects, can we thus select for fertility?
It is easy to assume that selecting the earliest calving heifers will improve fertility. However, the heritability of calving period is fairly low, thus it is likely that very little improvements in fertility would be made simply by selecting for those heifers that calved early in their first season (Lesmeister et al. 1973). Furthermore, the coefficient of genetic variation present in fertility is of similar magnitude to that present in production traits; however, traditional measurements of fertility such as age at puberty, calving interval, and pregnancy rate have low heritability ($h^2 < 0.05$), and recording is often poor, hindering identification of genetically superior animals (Breuel et al. 1993). Furthermore, the relatively low heritability of reproduction traits has made selection through the use of genetic technology relatively slow.

Using non-traditional measurements of fertility such as Antral follicle count can be used as an indicator of fertility in beef females (Cushman et al. 2009); additionally, interval to commencement of luteal activity postpartum (Royal et al. 2002) and interval from calving to postpartum ovulation (Darwash et al. 1997) have shown significant promise in identifying high fertility in dairy females. Selection indices for fertility based on these criteria (and others) have been developed in dairy industry (Miglior et al. 2005). Similar indices have been suggested for fertility in beef females (VanRaden 2005); although the majority of selection work in the beef industry has focused on production; sometimes at the detriment of fertility.

Therefore, the use of genetic markers for fertility are the most likely to generate any real advancements in selection tools. It is relatively unclear at this time whether we will be able to identify genetic markers for fertility. However, it is likely that a heifer’s age at first calving may be the best phenotypic indicator of fertility and likely is a promising population to use for finding genetic markers for fertility.

Conclusion

Heifers that calved early in the calving season with their first calf had increased longevity and kilograms weaned compared to heifers that calved later in the calving season; although the relative impact may be more pronounced in some herds than others. Furthermore, heifers that calve early in their first calving season may be the best phenotypic indicator of fertility. This suggests that identifying the heifers that calve early in the calving season may be the simplest method to improve longevity and profitability in beef herds.

References

Arthur, P.F., M. Makarechian, R.T. Berg, and R. Weingardt. 1993. Longevity and lifetime productivity of cows in a purebred Hereford and two multibreed synthetic groups under range conditions. J. Animal Sci. 71:1142-1147.

Breuel, K.F., P.E. Lewis, F.N. Schrick, A.W. Lishman, E.K. Inskeep, and R.L. Butcher. 1993. Factors affecting fertility in the postpartum cow: Role of the oocyte and follicle in conception rate. Biol. Repro. 48:655-661.

Cushman, R.A., M.F. Allan, L.A. Kuehn, W.M. Snelling, A.S. Cupp, and H.C. Freetly. 2009. Evaluation of antral follicle count and ovarian morphology in crossbred beef cows: Investigation of influence of stage of the estrous cycle, age, and birth weight. J. Anim. Sci. 87:1971-1980.

Darwash, A.O., G.E. Lamming, and J.A. Woolliams. 1997. Estimation of genetic variation in the interval from calving to postpartum ovulation of dairy cows. J. Dairy Sci. 80:1227-1234.

Deutscher, G.H., J.A. Stotts, and M.K. Nielsen. 1991. Effects of breeding season length and calving season on range beef cow productivity. J Anim Sci. 69:3453-3460.

Funston, R.N., J.A. Musgrave, T.L. Meyer, and D.M. Larson. 2011. Effect of calving period on ADG, reproduction, and first calf characteristics of heifer progeny. *Proc. West. Sec. Am. Soc. Anim. Sci.* 62:231-233.

Larson, D.M. and R.N. Funston. 2009. Estrous synchronization increases early calving frequency, which enhances steer progeny value. *Proc. West. Sec. Am. Soc. Anim. Sci.* 60:72-75.

Lesmeister, J.L., P.J. Burfening, and R.L. Blackwell. 1973. Date of first calving in beef cows and subsequent calf production. J. Anim. Sci. 36:1-6.

Miglior, F., B.L. Muir, and B.J. Van Doormaal. 2005. Selection indices in Holstein cattle of various countries. J. Dairy Sci. 88:1613.

NAHMS. 2008. Part IV: Reference of Beef Cow-calf Management Practices in the United States, 2007-08. USDA-APHIS Center for Epidemiology and Animal Health. Fort Collins, CO.

Patterson, D. J., R. C. Perry, G. H. Kiracofe, R. A. Bellows, R. B. Staigmiller, and L. R. Corah. 1992. Management considerations in heifer development and puberty. J Anim Sci. 70:4018-4035.

Royal, M.D., J.E. Pryce, J.A. Woolliams, and A.P.F. Flint. 2002. The genetic relationship between commencement of luteal activity and calving interval, body condition score, production, and linear type traits in Holstein-Friesian dairy cattle. J. Dairy Sci. 85:3071-3080.

VanRaden, P.M. 2005. An example from the dairy industry: The net merit index. In: Proceedings of the Beef Improvement Federation's 37th Annual Research Symposium and Annual Meeting, July 6-9, 2005, Billings, Montana, pp 96-100.

Notes