RANGE RESEARCH REPORT

Evaluation of Late Calving during Early May to Late June: Effects on Steer and Heifer Weight Gain

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Dickinson Research Extension Center

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The concept of changing calving dates from the long established traditional March period was initiated during the years when regional stockman attempted to develop a feedlot-slaughter plant system in the Northern Plains. The value added to finished beef animals was lost to the northern regions by shipping weaned calves and stockers to southern facilities. In order to keep a northern feedlot-slaughter plant system economically viable, regional calves would have needed to be available to enter the feedlots each month. Local cow-calf producers would have needed to adjust their calving dates. Even though the northern beef finishing system was not developed, several beef producers have ventured into, or have contemplated, changing their calving date. Unfortunately there is insufficient scientific data available that documents the positive and negative components involved when calving dates are changed from the regional traditional calving date.

Study Area

This project was conducted at the NDSU Dickinson Research Extension Center ranch located in Dunn county in western North Dakota, USA, at 47° 14' north latitude, 102° 50' west longitude. Mean annual temperature is 42.2° F (5.7° C). January is the coldest month, with a mean temperature of 14.6° F (-9.7° C). July and August are the warmest months, with mean temperatures of 69.6° F (20.9° C) and 68.6° F (20.4° C), respectively. Long-term (1982-2013) mean annual precipitation is 17.11 inches (434.60 mm). The perennial plant growing-season precipitation (April through October) is 14.37 inches (364.87 mm) and is 84.0% of the annual precipitation. June has the greatest monthly precipitation, at 3.24 inches (82.26 mm). The precipitation received during the 3-month period of May, June, and July (8.38 inches, 212.85 mm) accounts for 48.98% of the annual precipitation (Manske 2014). Soils are primarily Typic Haploborolls developed on sedimentary deposits. The fine loamy soils have 5 to 6 tons of organic nitrogen per acre. Native vegetation is the Wheatgrass-Needlegrass Type (Barker and Whitman 1988) of the mixed grass prairie.

Growing Season Precipitation

Growing season precipitation of 2010 was 16.18 inches (114.35% of LTM). April through July precipitation was 109.08% of LTM and August through October precipitation was 125.50% of LTM. Growing season precipitation of 2011 was 17.91 inches (126.57% of LTM). April through July precipitation was 134.26% of LTM and August through October precipitation was 109.62% of LTM. Growing season precipitation of 2012 was 13.63 inches (96.33% of LTM). April through July precipitation was 105.78% of LTM and August through October precipitation was 75.62% of LTM. Growing season precipitation of 2013 was 21.56 inches (152.37% of LTM). April through July precipitation was 133.88% of LTM and August through October precipitation was 192.39% of LTM. Mean growing season precipitation of 2010-2013 was 17.32 inches (122.40% of LTM). Mean April through July precipitation was 131.30% of LTM and mean August through October precipitation was 125.95% of LTM (tables 1 and 2).

Water stress develops in perennial plants during water deficiency periods when the amount of rainfall is less than evapotranspiration demand. Water deficiency months were identified from historical temperature and precipitation data by the ombrothermic diagram technique (Emberger et al. 1963). The frequency of water deficiency reoccurrence during April, May, June, and July is 15.6%, 9.4%, 9.4%, and 34.4%, respectively, and during August, September, and October water deficiency reoccurs 53.1%, 56.3%, and 34.4% of the growing seasons, respectively. Long-term occurrence of water deficiency conditions is 31.3% of the growing season months, for a mean of 2.0 water deficient months per growing season (Manske 2014). Water deficiency conditions occurred during August and October in 2010, during October in 2011, during August and September in 2012, and did not occur in 2013.

Procedures

The purpose of this research project is to describe differences in calf weight gain performance and to identify differences in forage costs and returns from pasture weight gains after forage costs that result from differences in early calf birth dates, early March to mid April, and late calf birth dates, early May to late June.

The range management grazing research projects conducted at the Dickinson Research Extension Center grazed spring and summer perennial grass pastures of the twice-over rotation system and the seasonlong system during the growing seasons from early May to mid October. Lowline X cows composed of 50% lowline and 50% angus and calves with birth dates during early March to mid April were used to graze the spring and summer perennial grass pastures during the growing seasons of 2010 and 2011. The calf birth dates for the lowline X cows were changed to late season calving during early May to late June in 2012 and 2013. These lowline X cows and calves with late birth dates were used to graze spring and summer perennial grass pastures of the twice-over rotation system and the seasonlong system during the growing seasons of 2012 and 2013.

The spring complementary crested wheatgrass pastures were grazed from early May to late May for 28 to 31 days. During the summer portion of the grazing season from early June to mid October, on the seasonlong system, one native rangeland pasture was grazed, and on the twice-over rotation system, three native rangeland pastures were grazed for two periods. During the first period of 45 days, each of the three pastures were grazed for 15 days between 1 June and 15 July (when lead tillers of grasses were between the 3.5 new leaf stage and the flower stage). During the second period of 90 days, each of the three pastures were grazed a second time for 30 days after 15 July and prior to mid October. The spring and summer perennial grass pastures were grazed during early May to mid October for 164 to 168 days. The spring and summer pastures of the seasonlong system and of the twice-over rotation grazing strategy had two replications each.

Forage costs were determined by the average pasture land rent per acre from western North Dakota at $8.76 per acre and the land area in acres needed to feed a cow and calf during the grazing period. Forage cost per day was determined by dividing the total forage cost by the number of days on pasture. Dollar value of calf pasture weight gain was determined from the accumulated calf weight gain which was the difference of the calf live weight at the beginning of the growth period from the calf live weight at the end of the growth period. The calf accumulated pasture weight gain was multiplied by an assumed market value of $1.25 per pound. Net return after forage costs per cow-calf pair was determined by subtracting the forage costs from the dollar value of calf pasture weight gain. Net return after forage costs per acre was determined by dividing the net return per cow-calf pair by the land area in acres needed per cow-calf pair. Net return per 640 acres was determined by multiplying the net return per acre by 640 acres. Cost per pound of calf pasture weight gain was determined by dividing the forage costs by the pounds of accumulated calf weight. Calf weaning weight as a percentage of cow weight was determined by dividing the average calf weaning weight by the average cow weight at weaning.

Calf pasture weight gains, pasture forage costs, and net returns from pasture weight gains after forage costs were determined for the lowline X calves born in 2012 and 2013 with late birth dates during early May to late June, and for the lowline X calves born in 2010 and 2011 with early birth dates during early March to mid April.

Results

Calf Gains on Crested Wheatgrass

Pasture weight gains of steer and heifer lowline X calves with birth dates during the late (May) calving season were compared to that of steer and heifer lowline X calves with birth dates during the early (March) calving season with cows grazing the complementary crested wheatgrass pastures of the seasonlong grazing system and of the twice-over rotation system (tables 3 and 4).

Mean calf weight gain on crested wheatgrass pastures of the seasonlong system for steer calves with late birth dates was 0.57 lbs per day, 9.91 lbs per acre, and accumulated weight gain was 19.23 lbs. Mean calf weight gain on crested wheatgrass pastures of the seasonlong system for steer calves with early birth dates was 1.91 lbs per day, 27.65 lbs per acre, and accumulated weight gain was 53.46 lbs. The early born steer lowline X calves on the crested wheatgrass pastures of the seasonlong system had 235.1% greater gain per day, 178.1% greater gain per acre, and accumulated weight gain was 34.23 lbs (178.0%) greater than the weight gain for the late born steer calves (table 3).

Mean calf weight gain on crested wheatgrass pastures of the seasonlong system for heifer calves with late birth dates was 0.76 lbs per day, 13.26 lbs per acre, and accumulated weight gain was 25.72 lbs. Mean calf weight gain on crested wheatgrass pastures of the seasonlong system for heifer calves with early birth dates was 2.01 lbs per day, 29.07 lbs per acre, and accumulated weight gain was 56.40 lbs. The early born heifer lowline X calves on the crested wheatgrass pastures of the seasonlong system had 164.5% greater gain per day, 119.2% greater gain per acre, and accumulated weight gain was 30.68 lbs (119.3%) greater than the weight gain for the late born heifer calves (table 3).

Mean calf weight gain on crested wheatgrass pastures of the twice-over rotation system for steer calves with late birth dates was 1.15 lbs per day, 32.12 lbs per acre, and accumulated weight gain was 39.19 lbs. Mean calf weight gain on crested wheatgrass pastures of the twice-over rotation system for steer calves with early birth dates was 2.08 lbs per day, 47.69 lbs per acre, and accumulated weight gain was 58.18 lbs. The early born steer lowline X calves on the crested wheatgrass pastures of the twice-over rotation system had 80.9% greater gain per day, 48.5% greater gain per acre, and accumulated weight gain was 19.00 lbs (48.5%) greater than the weight gain for the late born steer calves (table 4).

Mean calf weight gain on crested wheatgrass pastures of the twice-over rotation system for heifer calves with late birth dates was 1.04 lbs per day, 28.93 lbs per acre, and accumulated weight gain was 35.29 lbs. Mean calf weight gain on crested wheatgrass pastures of the twice-over rotation system for heifer calves with early birth dates was 1.79 lbs per day, 41.12 lbs per acre, and accumulated weight gain was 50.17 lbs. The early born heifer lowline X calves on the crested wheatgrass pastures of the twice-over rotation system had 72.1% greater gain per day, 42.1% greater gain per acre, and accumulated weight gain was 14.88 lbs (42.2%) greater than the weight gain for the late born heifer calves (table 4).

Calf Gains on Native Rangeland

Pasture weight gains of steer and heifer lowline X calves with birth dates during the late (May) calving season were compared to that of steer and heifer lowline X calves with birth dates during the early (March) calving season with cows grazing the native rangeland pastures of the seasonlong grazing system and of the twice-over rotation system (tables 3 and 4).

Mean calf weight gain on native rangeland pastures of the seasonlong system for steer calves with late birth dates was 2.46 lbs per day, 31.95 lbs per acre, and accumulated weight gain was 329.77 lbs. Mean calf weight gain on native rangeland pastures of the seasonlong system for steer calves with early birth dates was 2.50 lbs per day, 32.88 lbs per acre, and accumulated weight gain was 339.34 lbs. The early born steer lowline X calves on the native rangeland pastures of the seasonlong system had 1.6% greater gain per day, 2.9% greater gain per acre, and accumulated weight gain was 9.57 lbs (0.3%) greater than the weight gain for the late born steer calves (table 3).

Mean calf weight gain on native rangeland pastures of the seasonlong system for heifer calves with late birth dates was 2.16 lbs per day, 28.08 lbs per acre, and accumulated weight gain was 289.78 lbs. Mean calf weight gain on native rangeland pastures of the seasonlong system for heifer calves with early birth dates was 2.25 lbs per day, 29.63 lbs per acre, and accumulated weight gain was 305.74 lbs. The early born heifer lowline X calves on the native rangeland pastures of the seasonlong system had 4.2% greater gain per day, 5.5% greater gain per acre, and accumulated weight gain was 15.96 lbs (5.5%) greater than the weight gain for the late born heifer calves (table 3).

Mean calf weight gain on native rangeland pastures of the twice-over rotation system for steer calves with late birth dates was 2.32 lbs per day, 30.39 lbs per acre, and accumulated weight gain was 310.56 lbs. Mean calf weight gain on native rangeland pastures of the twice-over rotation system for steer calves with early birth dates was 2.59 lbs per day, 34.42 lbs per acre, and accumulated weight gain was 351.72 lbs. The early born steer lowline X calves on the native rangeland pastures of the twice-over rotation system had 11.6% greater gain per day, 13.3% greater gain per acre, and accumulated weight gain was 41.16 lbs (13.3%) greater than the weight gain for the late born steer calves (table 4).

Mean calf weight gain on native rangeland pastures of the twice-over rotation system for heifer calves with late birth dates was 2.17 lbs per day, 28.45 lbs per acre, and accumulated weight gain was 290.78 lbs. Mean calf weight gain on native rangeland pastures of the twice-over rotation system for heifer calves with early birth dates was 2.31 lbs per day, 30.73 lbs per acre, and accumulated weight gain was 314.06 lbs. The early born heifer lowline X calves on the native rangeland pastures of the twice-over rotation system had 6.5% greater gain per day, 8.0% greater gain per acre, and accumulated weight gain was 23.28 lbs (8.0%) greater than the weight gain for the late born heifer calves (table 4).

The steer and heifer lowline X calves on the crested wheatgrass and native rangeland pastures of the seasonlong system with early (March) birth dates had greater weight gain performance than the steer and heifer calves with late (May) birth dates (table 3).

The steer and heifer lowline X calves on the crested wheatgrass and native rangeland pastures of the twice-over rotation system with early (March) birth dates had greater weight gain performance than the steer and heifer calves with late (May) birth dates (table 4).

Calf Performance on the Seasonlong System

The spring and summer pastures of the seasonlong system were grazed for 168 days from early May to mid October by cows with steer lowline X calves that had late birth dates with an average on 28 May. A cow-calf pair was allotted 12.26 acres for the production period (1.94 acres of crested wheatgrass and 10.32 acres of native rangeland); at a pasture rent value of $8.76 per acre, the forage cost was $107.40 per period, or $0.64 per day. The mean steer calf weight gain was 2.08 lbs per day, 28.47 lbs per acre, and accumulated weight gain was 349.00 lbs. When calf accumulated weight was assumed to have a value of $1.25 per pound, the gross return was $436.25 per calf, and the net returns after pasture costs were $328.85 per cow-calf pair and $26.82 per acre. The net returns after pasture costs on 640 acres was $17,164.80. The cost of calf weight gain was $0.31 per pound. The mean calf final pasture live weight was 424.92 lbs and was 37.4% of the mean cow weight (table 5).

The spring and summer pastures of the seasonlong system were grazed for 164 days from early May to mid October by cows with steer lowline X calves that had early birth dates with an average on 20 March. A cow-calf pair was allotted 12.26 acres for the production period (1.94 acres of crested wheatgrass and 10.32 acres of native rangeland); at a pasture rent value of $8.76 per acre, the forage cost was $107.40 per period, or $0.65 per day. The mean steer calf weight gain was 2.40 lbs per day, 32.04 lbs per acre, and accumulated weight gain was 392.80 lbs. When calf accumulated weight was assumed to have a value of $1.25 per pound, the gross return was $491.00 per calf, and the net returns after pasture costs were $383.60 per cow-calf pair and $31.29 per acre. The net returns after pasture costs on 640 acres was $20,025.60. The cost of calf weight gain was $0.27 per pound. The mean calf final pasture live weight was 546.67 lbs and was 50.3% of the mean cow weight (table 5).

The early born steer calves on the seasonlong system had 15.4% greater gain per day, 12.5% greater gain per acre, and accumulated 43.80 lbs (12.6%) greater weight gain than that of the late born steer calves. The net returns after pasture costs for the early born steer calves were $54.75 (16.6%) greater per cow-calf pair, $4.47 (16.7%) greater per acre, and $2,860.80 (16.7%) greater per 640 acres, and the final pasture live weight was 121.75 lbs (28.7%) greater than those of the late born steer calves on the seasonlong system (table 5).

The spring and summer pastures of the seasonlong system were grazed for 168 days from early May to mid October by cows with heifer lowline X calves that had late birth dates with an average on 25 May. A cow-calf pair was allotted 12.26 acres for the production period (1.94 acres of crested wheatgrass and 10.32 acres of native rangeland); at a pasture rent value of $8.76 per acre, the forage cost was $107.40 per period, or $0.64 per day. The mean heifer calf weight gain was 1.88 lbs per day, 25.73 lbs per acre, and accumulated weight gain was 315.50 lbs. When calf accumulated weight was assumed to have a value of $1.25 per pound, the gross return was $394.38 per calf, and the net returns after pasture costs were $286.98 per cow-calf pair and $23.41 per acre. The net returns after pasture costs on 640 acres was $14,982.40. The cost of calf weight gain was $0.34 per pound. The mean calf final pasture live weight was 386.14 lbs and was 34.6% of the mean cow weight (table 5).

The spring and summer pastures of the seasonlong system were grazed for 164 days from early May to mid October by cows with heifer lowline X calves that had early birth dates with an average on 13 March. A cow-calf pair was allotted 12.26 acres for the production period (1.94 acres of crested wheatgrass and 10.32 acres of native rangeland); at a pasture rent value of $8.76 per acre, the forage cost was $107.40 per period, or $0.65 per day. The mean heifer calf weight gain was 2.21 lbs per day, 29.54 lbs per acre, and accumulated weight gain was 362.14 lbs. When calf accumulated weight was assumed to have a value of $1.25 per pound, the gross return was $452.68 per calf, and the net returns after pasture costs were $345.28 per cow-calf pair and $28.16 per acre. The net returns after pasture costs on 640 acres was $18,022.40. The cost of calf weight gain was $0.30 per pound. The mean calf final pasture live weight was 517.07 lbs and was 48.1% of the mean cow weight (table 5).

The early born heifer calves on the seasonlong system had 17.6% greater gain per day, 14.8% greater gain per acre, and accumulated 46.64 lbs (14.8%) greater weight gain than that of the late born heifer calves. The net returns after pasture costs for the early born heifer calves were $58.30 (20.3%) greater per cow-calf pair, $4.75 (20.3%) greater per acre, and $3,040.00 (20.3%) greater per 640 acres, and the final pasture live weight was 130.93 lbs (33.9%) greater than those of the late born heifer calves on the seasonlong system (table 5).

Calf Performance on the Twice-over System

The spring and summer pastures of the twice-over rotation system were grazed for 168 days from early May to mid October by cows with steer lowline X calves that had late birth dates with an average on 24 May. A cow-calf pair was allotted 11.44 acres for the production period (1.22 acres of crested wheatgrass and 10.22 acres of native rangeland); at a pasture rent value of $8.76 per acre, the forage cost was $100.21 per period, or $0.60 per day. The mean steer calf weight gain was 2.08 lbs per day, 30.57 lbs per acre, and accumulated weight gain was 349.75 lbs. When calf accumulated weight was assumed to have a value of $1.25 per pound, the gross return was $437.19 per calf, and the net returns after pasture costs were $336.98 per cow-calf pair and $29.46 per acre. The net returns after pasture costs on 640 acres was $18,854.40. The cost of calf weight gain was $0.29 per pound. The mean calf final pasture live weight was 428.95 lbs and was 37.6% of the mean cow weight (table 6).

The spring and summer pastures of the twice-over rotation system were grazed for 164 days from early May to mid October by cows with steer lowline X calves that had early birth dates with an average on 19 March. A cow-calf pair was allotted 11.44 acres for the production period (1.22 acres of crested wheatgrass and 10.22 acres of native rangeland); at a pasture rent value of $8.76 per acre, the forage cost was $100.21 per period, or $0.61 per day. The mean steer calf weight gain was 2.50 lbs per day, 35.83 lbs per acre, and accumulated weight gain was 409.90 lbs. When calf accumulated weight was assumed to have a value of $1.25 per pound, the gross return was $512.38 per calf, and the net returns after pasture costs were $412.17 per cow-calf pair and $36.03 per acre. The net returns after pasture costs on 640 acres was $23,059.20. The cost of calf weight gain was $0.24 per pound. The mean calf final pasture live weight was 575.02 lbs and was 54.3% of the mean cow weight (table 6).

The early born steer calves on the twice-over rotation system had 20.2% greater gain per day, 17.2% greater gain per acre, and accumulated 60.15 lbs (17.2%) greater weight gain than that of the late born steer calves. The net returns after pasture costs for the early born steer calves were $75.19 (22.3%) greater per cow-calf pair, $6.57 (22.3%) greater per acre, and $4,204.80 (22.3%) greater per 640 acres, and the final pasture live weight was 146.07 lbs (34.1%) greater than those of the late born steer calves on the twice-over rotation system (table 6).

The spring and summer pastures of the twice-over rotation system were grazed for 168 days from early May to mid October by cows with heifer lowline X calves that had late birth dates with an average on 24 May. A cow-calf pair was allotted 11.44 acres for the production period (1.22 acres of crested wheatgrass and 10.22 acres of native rangeland); at a pasture rent value of $8.76 per acre, the forage cost was $100.21 per period, or $0.60 per day. The mean heifer calf weight gain was 1.94 lbs per day, 28.50 lbs per acre, and accumulated weight gain was 326.07 lbs. When calf accumulated weight was assumed to have a value of $1.25 per pound, the gross return was $407.59 per calf, and the net returns after pasture costs were $307.38 per cow-calf pair and $26.87 per acre. The net returns after pasture costs on 640 acres was $17,196.80. The cost of calf weight gain was $0.31 per pound. The mean calf final pasture live weight was 399.07 lbs and was 36.3% of the mean cow weight (table 6).

The spring and summer pastures of the twice-over rotation system were grazed for 164 days from early May to mid October by cows with heifer lowline X calves that had early birth dates with an average on 17 March. A cow-calf pair was allotted 11.44 acres for the production period (1.22 acres of crested wheatgrass and 10.22 acres of native rangeland); at a pasture rent value of $8.76 per acre, the forage cost was $100.21 per period, or $0.61 per day. The mean heifer calf weight gain was 2.22 lbs per day, 31.84 lbs per acre, and accumulated weight gain was 364.23 lbs. When calf accumulated weight was assumed to have a value of $1.25 per pound, the gross return was $455.29 per calf, and the net returns after pasture costs were $355.08 per cow-calf pair and $31.04 per acre. The net returns after pasture costs on 640 acres was $19,865.60. The cost of calf weight gain was $0.28 per pound. The mean calf final pasture live weight was 518.53 lbs and was 49.1% of the mean cow weight (table 6).

The early born heifer calves on the twice-over rotation system had 14.4% greater gain per day, 11.7% greater gain per acre, and accumulated 38.16 lbs (11.7%) greater weight gain than that of the late born heifer calves. The net returns after pasture costs for the early born heifer calves were $47.70 (15.5%) greater per cow-calf pair, $4.17 (15.5%) greater per acre, and $2,668.80 (15.5%) greater per 640 acres, and the final pasture live weight was 119.46 lbs (29.9%) greater than those of the late born heifer calves on the twice-over rotation system (table 6).

The steer and heifer lowline X calves on the twice-over rotation system had greater weight gains and greater wealth captured from the land natural resources than the steer and heifer calves on the seasonlong system. The early born steer and heifer lowline X calves had greater weight gain per day, greater weight gain per acre, and accumulated greater pasture weight than the late born steer and heifer calves. The net returns after pasture costs for the early born steer and heifer calves were greater per cow-calf pair, greater per acre, and greater per 640 acres, and the final pasture live weight was greater than those of the late born steer and heifer calves on both the twice-over rotation system and seasonlong system.

Discussion

Beef livestock agriculture has high production costs and low profit margins because modern high-performance cattle are still being fed with old-style traditional type forage management practices as a direct result from the common assumption that beef weight is the source of income and forage feed is an expense. Beef producers have transformed old-style, low performance cattle into high-performance, fast-growing meat animals with improved genetic potential and increased nutrient demands. Modern, high-performance cattle are larger and heavier, gain weight more rapidly, produce more milk, and deposit less fat on their bodies than old-style cattle. However, the beef production industry has not similarly improved the efficiency and production of forage feed management systems for brood cows. The asymmetrical mismatch between the quantity of forage nutrients required by modern, high-performance cows and the quantity of forage nutrients provided from traditional forage management practices perpetuates the problems with both modern cattle performance and grassland ecosystem productivity to remain at less than potential levels (Manske and Schneider 2008b).

Modern high-performance beef cattle produce at their genetic potentials when their nutrient requirements are met each day (Manske and Schneider 2007). Perennial grassland ecosystems produce at potential levels when the biological requirements of the plants and soil organisms are met (Manske 2011b). The renewable forage plant nutrients produced on the land natural resources are the original source of new wealth generated by beef livestock agriculture (Manske and Schneider 2008b).

The nutrient requirements for beef cows above maintenance levels varies with the changes in nutrient demand from milk production for the nursing calf as it grows and with the changes in nutrient demand of the physiological preparation for breeding and the development of the fetus that will be the next calf (BCRC 1999).

The annual nutritional quality curves of available perennial forage plants change with the development of the phenological growth stages. Plant growth is triggered by changes in day length (photoperiod). Domesticated grasses are physiologically ready for grazing in early May and they have the highest levels of crude protein during May. Native cool-season grasses are physiologically ready for grazing in early June and they have adequate levels of crude protein from early June to the middle of July. Native warm-season grasses are physiologically ready for grazing in mid June and they have adequate levels of crude protein from June to late July (Whitman et al. 1951, Manske 2008a, 2011a). Adequate crude protein levels from native cool-season and warm-season grasses can be extended to late September or mid October by stimulation of vegetative tillers during the period of early June to mid July (Manske 2011b).

The nutritional quality curves of available perennial grasses cannot be changed. The time of year during which the cow production periods with different nutritional requirements occur can be changed and synchronized with the nutritional quality curves of the perennial grasses by rationally setting the calving date which is determined by the breeding date. The nutritional quality curves of the common domesticated grasses and the native rangeland grasses in the Northern Plains match the nutritional requirement curves of the spring and summer lactation production periods of cows with calving dates during January through March (Manske 2002, 2008a).

The nutrients are the valuable products produced by forage plants on the land. The cow processes the forage nutrients and produces milk resulting in calf weight accumulation. The calf weight is the commodity sold at the market, nevertheless, the original source of the income from the sale of beef weight is the forage nutrients. The renewable forage nutrients are the primary unit of production in a beef operation, and they are the source of new wealth from agricultural use of grazingland and hayland resources (Manske and Schneider 2007).

The quantity of new wealth generated from agricultural use of land resources is limited by the biological capacity of the forage plants to produce herbage and nutrients from soil, sunlight, water, and carbon dioxide and by the effectiveness of management treatments in capturing value from plant production. Increasing value captured from the land requires using biologically effective forage management strategies that place priority on plant health and stimulate ecological biogeochemical processes, enhance vegetative plant growth, capture a high proportion of the produced nutrients, and efficiently convert these nutrients into saleable commodities such as calf weight (Manske and Schneider 2007).

The quantity of crude protein captured per acre as livestock feed is the factor that has the greatest influence on the costs of pasture forage and harvested forage and on the amount of new wealth generated from the land resources. The weight of crude protein captured per acre is related to the percent crude protein content and the weight of the forage dry matter at the time of grazing or haying. The cost per pound of crude protein is determined by the weight of the crude protein captured per acre prorated against the forage production costs which include the land costs, equipments costs, and labor costs per acre. Reductions in livestock feed costs result from capturing greater quantities of crude protein per acre. Capturing greater quantities of the produced crude protein from a land base causes reduction in the amount of land area required to feed a cow-calf pair and results in lowering the forage feed costs because the forage production costs per acre are spread over a greater number of pounds of crude protein (Manske and Schneider 2007).

The nutritional quality curves of the domesticated perennial grasses and the native rangeland perennial grasses in the Northern Plains are not synchronized with the nutritional requirement curves of the production periods of cows with calving dates during the perennial grass growing season, April through October (Manske 2002). When the nutrient quality curves of the available perennial forage grasses and nutrient requirement curves of beef cows are not synchronized, modern high-performance beef cattle do not produce at genetic potentials, perennial grassland ecosystems do not produce at biogeochemical potentials, and new wealth captured from forage plant nutrients through beef weight gain is not generated at potential levels. Forage nutrients from sources other than perennial grasses is required to provide low-cost feed for beef cows with calving dates during April through October (Manske 2002).

Lower forage feed costs and greater net returns after forage costs are largely determined by the biological effectiveness of meeting the plant and soil organism requirements, the efficiency of crude protein capture per acre, and the efficiency at conversion of forage crude protein into a saleable product like calf weight resulting from biologically effective forage management strategies that have the nutrient requirement curves of cow production periods synchronized with the nutrient quality curves of the available perennial forage grasses (Manske and Schneider 2007).

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Table 1. Precipitation in inches for growing season months of 2010-2013, DREC Ranch, North Dakota.

	Apr	May	Jun	Jul	Aug	Sep	Oct	Growing Season
Long-term mean	1.41	2.60	3.24	2.44	1.73	1.46	1.28	14.15
2010	1.43	3.70	3.50	1.94	1.39	4.09	0.13	16.18
% of LTM	101.42	142.31	108.02	79.51	80.35	280.14	10.16	114.35
2011	1.66	6.87	2.15	2.33	2.70	1.76	0.44	17.91
% of LTM	117.73	264.23	66.36	95.49	156.07	120.55	34.38	126.57
2012	2.38	1.58	4.31	1.98	0.82	0.21	2.35	13.63
% of LTM	168.79	60.77	133.02	81.15	47.40	14.38	183.59	96.33
2013	1.05	7.55	2.23	2.13	2.81	2.44	3.35	21.56
% of LTM	74.47	290.38	68.83	87.30	162.43	167.12	261.72	152.37
Mean	1.63	4.93	3.05	2.10	1.93	2.13	1.57	17.32
% of LTM	115.60	189.42	94.06	85.86	111.56	145.55	122.46	122.40

Table 2. Running total precipitation in inches for growing season months of 2010-2013, DREC Ranch, North Dakota.

	Apr	May	Jun	Jul	Aug	Sep	Oct
Long-term mean 1982-2011	1.41	4.01	7.25	9.69	11.42	12.88	14.15
2010	1.43	5.13	8.63	10.57	11.96	16.05	16.18
% of LTM	101.42	127.93	119.03	109.08	104.73	124.61	114.35
2011	1.66	8.53	10.68	13.01	15.71	17.47	17.91
% of LTM	117.73	212.72	147.31	134.26	137.57	135.64	126.57
2012	2.38	3.96	8.27	10.25	11.07	11.28	13.63
% of LTM	168.79	98.75	114.07	105.78	96.94	87.58	96.33
2013	1.05	8.60	10.83	12.96	15.77	18.21	21.56
% of LTM	74.47	214.46	149.38	133.75	138.09	141.38	152.37
Mean	1.63	6.56	9.60	11.70	13.63	15.75	17.32
% of LTM	115.60	163.47	132.45	120.72	119.33	122.30	122.40

Table 3. Weight gain for steer and heifer lowline X calves with early and late birth dates, grazing spring and summer seasonlong system pastures, from early May to mid October.

Seasonlong		Crested Wheatgrass	Native Rangeland 1st Period	Native Rangeland 2nd Period	Total Native	Total Season	Final Pasture Weight
2010-2011		Early Birth Date					
Steer							
Weight Gain	lbs	53.46	108.80	230.54	339.34	392.80	546.67
Gain/Day	lbs	1.91	2.44	2.52	2.50	2.40	
Gain/Acre	lbs	27.56	10.54	22.34	32.88	32.04	
Heifer							
Weight Gain	lbs	56.40	102.00	203.74	305.74	362.14	517.07
Gain/Day	lbs	2.01	2.29	2.23	2.25	2.21	
Gain/Acre	lbs	29.07	9.88	19.74	29.63	29.54	
2012-2013		Late Birth Date					
Steer							
Weight Gain	lbs	19.23	109.77	220.00	329.77	349.00	424.92
Gain/Day	lbs	0.57	2.55	2.42	2.46	2.08	
Gain/Acre	lbs	9.91	10.64	21.32	31.95	28.47	
Heifer							
Weight Gain	lbs	25.72	98.21	191.57	289.78	315.50	386.14
Gain/Day	lbs	0.76	2.28	2.11	2.16	1.88	
Gain/Acre	lbs	13.26	9.52	18.56	28.08	25.73	

Table 4. Weight gain for steer and heifer lowline X calves with early and late birth dates, grazing spring and summer twice-over rotation system pastures, from early May to mid October.

Twice-over Rotation		Crested Wheatgrass	Native Rangeland 1st Rotation	Native Rangeland 2nd Rotation	Total Native	Total Season	Final Pasture Weight
2010-2011		Early Birth Date					
Steer							
Weight Gain	lbs	58.18	113.58	238.14	351.72	409.90	575.02
Gain/Day	lbs	2.08	2.55	2.60	2.59	2.50	
Gain/Acre	lbs	47.69	11.11	23.30	34.42	35.83	
Heifer							
Weight Gain	lbs	50.17	104.00	210.06	314.06	364.23	518.53
Gain/Day	lbs	1.79	2.34	2.30	2.31	2.22	
Gain/Acre	lbs	41.12	10.18	20.55	30.73	31.84	
2012-2013		Late Birth Date					
Steer							
Weight Gain	lbs	39.19	102.37	208.19	310.56	349.75	428.95
Gain/Day	lbs	1.15	2.38	2.29	2.32	2.08	
Gain/Acre	lbs	32.12	10.02	20.37	30.39	30.57	
Heifer							
Weight Gain	lbs	35.29	99.58	191.20	290.78	326.07	399.07
Gain/Day	lbs	1.04	2.32	2.10	2.17	1.94	
Gain/Acre	lbs	28.93	9.74	18.71	28.45	28.50	

Table 5. Weight gain, costs, and net returns for steer and heifer lowline X calves with early and late birth date categories grazing spring and summer seasonlong system pastures, from early May to mid October.

		Early Birth Date		Late Birth Date	
Calf Birth Dates		Steer	Heifer	Steer	Heifer
Birth Date		20 Mar	13 Mar	28 May	25 May
Birth Weight	lbs	71.9	67.1	75.9	70.6
Land Rent	$	8.76	8.76	8.76	8.76
Land Area	ac	12.26	12.26	12.26	12.26
Forage Costs	$	107.40	107.40	107.40	107.40
Days on Pasture		164.00	164.00	168.00	168.00
Cost/Day	$	0.65	0.65	0.64	0.64
Calf Wt					
Pasture Gain	lbs	392.80	362.14	349.00	315.50
Gain/Day	lbs	2.40	2.21	2.08	1.88
Gain/Acre	lbs	32.04	29.54	28.47	25.73
Wt Value@$1.25/lb		491.00	452.68	436.25	394.38
Net Return/Cow	$	383.60	345.28	328.85	286.98
Net Return/Acre	$	31.29	28.16	26.82	23.41
Cost/lb Gain	$	0.27	0.30	0.31	0.34
Weaning Wt	lbs	546.67	517.07	424.92	386.14
% Cow Wt		50.3	48.1	37.4	34.6
C-Cprs/640 ac		52	52	52	52
Net Return/640 ac	$	20,025.60	18,022.40	17,164.80	14,982.40

Table 6. Weight gain, costs, and net returns for steer and heifer lowline X calves with early and late birth date categories grazing spring and summer twice-over rotation system pastures, from early May to mid October.

		Early Birth Date		Late Birth Date	
Calf Birth Dates		Steer	Heifer	Steer	Heifer
Birth Date		19 Mar	17 Mar	24 May	24 May
Birth Weight	lbs	74.5	70.1	79.2	73.0
Land Rent	$	8.76	8.76	8.76	8.76
Land Area	ac	11.44	11.44	11.44	11.44
Forage Costs	$	100.21	100.21	100.21	100.21
Days on Pasture		164.00	164.00	168.00	168.00
Cost/Day	$	0.61	0.61	0.60	0.60
Calf Wt					
Pasture Gain	lbs	409.90	364.23	349.75	326.07
Gain/Day	lbs	2.50	2.22	2.08	1.94
Gain/Acre	lbs	35.83	31.84	30.57	28.50
Wt Value@$1.25/lb		512.38	455.29	437.19	407.59
Net Return/Cow	$	412.17	355.08	336.98	307.38
Net Return/Acre	$	36.03	31.04	29.46	26.87
Cost/lb Gain	$	0.24	0.28	0.29	0.31
Weaning Wt	lbs	575.02	518.53	428.95	399.07
% Cow Wt		54.3	49.1	37.6	36.3
C-Cprs/640 ac		56	56	56	56
Net Return/640 ac	$	23,059.20	19,865.60	18,854.40	17,196.80

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RANGE RESEARCH REPORT

Evaluation of Late Calving during Early May to Late June: Effects on Calves Born during the Early, Middle, and Late Periods

North Dakota State University
Dickinson Research Extension Center

Dickinson, North Dakota
October 2014

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The concept of changing calving dates from the long established traditional March period was initiated during the years when regional stockman attempted to develop a feedlot-slaughter plant system in the Northern Plains. The value added to finished beef animals was lost to the northern regions by shipping weaned calves and stockers to southern facilities. In order to keep a northern feedlot-slaughter plant system economically viable, regional calves would have needed to be available to enter the feedlots each month. Local cow-calf producers would have needed to adjust their calving dates. Even though the northern beef finishing system was not developed, several beef producers have ventured into, or have contemplated, changing their calving date. Unfortunately there is insufficient scientific data available that documents the positive and negative components involved when calving dates are changed from the regional traditional calving date.

Study Area

This project was conducted at the NDSU Dickinson Research Extension Center ranch located in Dunn county in western North Dakota, USA, at 47° 14' north latitude, 102° 50' west longitude. Mean annual temperature is 42.2° F (5.7° C). January is the coldest month, with a mean temperature of 14.6° F (-9.7° C). July and August are the warmest months, with mean temperatures of 69.6° F (20.9° C) and 68.6° F (20.4° C), respectively. Long-term (1982-2013) mean annual precipitation is 17.11 inches (434.60 mm). The perennial plant growing-season precipitation (April through October) is 14.37 inches (364.87 mm) and is 84.0% of the annual precipitation. June has the greatest monthly precipitation, at 3.24 inches (82.26 mm). The precipitation received during the 3-month period of May, June, and July (8.38 inches, 212.85 mm) accounts for 48.98% of the annual precipitation (Manske 2014). Soils are primarily Typic Haploborolls developed on sedimentary deposits. The fine loamy soils have 5 to 6 tons of organic nitrogen per acre. Native vegetation is the Wheatgrass-Needlegrass Type (Barker and Whitman 1988) of the mixed grass prairie.

Growing Season Precipitation

Growing season precipitation of 2010 was 16.18 inches (114.35% of LTM). April through July precipitation was 109.08% of LTM and August through October precipitation was 125.50% of LTM. Growing season precipitation of 2011 was 17.91 inches (126.57% of LTM). April through July precipitation was 134.26% of LTM and August through October precipitation was 109.62% of LTM. Growing season precipitation of 2012 was 13.63 inches (96.33% of LTM). April through July precipitation was 105.78% of LTM and August through October precipitation was 75.62% of LTM. Growing season precipitation of 2013 was 21.56 inches (152.37% of LTM). April through July precipitation was 133.88% of LTM and August through October precipitation was 192.39% of LTM. Mean growing season precipitation of 2010-2013 was 17.32 inches (122.40% of LTM). Mean April through July precipitation was 131.30% of LTM and mean August through October precipitation was 125.95% of LTM (tables 1 and 2).

Water stress develops in perennial plants during water deficiency periods when the amount of rainfall is less than evapotranspiration demand. Water deficiency months were identified from historical temperature and precipitation data by the ombrothermic diagram technique (Emberger et al. 1963). The frequency of water deficiency reoccurrence during April, May, June, and July is 15.6%, 9.4%, 9.4%, and 34.4%, respectively, and during August, September, and October water deficiency reoccurs 53.1%, 56.3%, and 34.4% of the growing seasons, respectively. Long-term occurrence of water deficiency conditions is 31.3% of the growing season months, for a mean of 2.0 water deficient months per growing season (Manske 2014). Water deficiency conditions occurred during August and October in 2010, during October in 2011, during August and September in 2012, and did not occur in 2013.

Procedures

The purpose of this research project is to describe differences in calf weight gain performance and to identify differences in forage costs and returns from pasture weight gains after forage costs that result from differences in early calf birth dates, early March to mid April, and late calf birth dates, early May to late June.

The range management grazing research projects conducted at the Dickinson Research Extension Center grazed spring and summer perennial grass pastures of the twice-over rotation system and the seasonlong system during the growing seasons from early May to mid October. Lowline X cows composed of 50% lowline and 50% angus and calves with birth dates during early March to mid April were used to graze the spring and summer perennial grass pastures during the growing seasons of 2010 and 2011. The calf birth dates for the lowline X cows were changed to late season calving during early May to late June in 2012 and 2013. These lowline X cows and calves with late birth dates were used to graze spring and summer perennial grass pastures of the twice-over rotation system and the seasonlong system during the growing seasons of 2012 and 2013.

The spring complementary crested wheatgrass pastures were grazed from early May to late May for 28 to 31 days. During the summer portion of the grazing season from early June to mid October, on the seasonlong system, one native rangeland pasture was grazed, and on the twice-over rotation system, three native rangeland pastures were grazed for two periods. During the first period of 45 days, each of the three pastures were grazed for 15 days between 1 June and 15 July (when lead tillers of grasses were between the 3.5 new leaf stage and the flower stage). During the second period of 90 days, each of the three pastures were grazed a second time for 30 days after 15 July and prior to mid October. The spring and summer perennial grass pastures were grazed during early May to mid October for 164 to 168 days. The spring and summer pastures of the seasonlong system and of the twice-over rotation grazing strategy had two replications each.

Forage costs were determined by the average pasture land rent per acre from western North Dakota at $8.76 per acre and the land area in acres needed to feed a cow and calf during the grazing period. Forage cost per day was determined by dividing the total forage cost by the number of days on pasture. Dollar value of calf pasture weight gain was determined from the accumulated calf weight gain which was the difference of the calf live weight at the beginning of the growth period from the calf live weight at the end of the growth period. The calf accumulated pasture weight gain was multiplied by an assumed market value of $1.25 per pound. Net return after forage costs per cow-calf pair was determined by subtracting the forage costs from the dollar value of calf pasture weight gain. Net return after forage costs per acre was determined by dividing the net return per cow-calf pair by the land area in acres needed per cow-calf pair. Net return per 640 acres was determined by multiplying the net return per acre by 640 acres. Cost per pound of calf pasture weight gain was determined by dividing the forage costs by the pounds of accumulated calf weight. Calf weaning weight as a percentage of cow weight was determined by dividing the average calf weaning weight by the average cow weight at weaning.

Calf pasture weight gains, pasture forage costs, and net returns from pasture weight gains after forage costs were determined for the lowline X calves born in 2012 and 2013 with late birth dates during early May to late June, and for the lowline X calves born in 2010 and 2011 with early birth dates during early March to mid April.

Results

Calf Gains Compared

Pasture weight gains of lowline X calves with late (May) birth dates were compared to that of lowline X calves with early (March) birth dates with cows grazing spring and summer pastures of the seasonlong system (table 3). The mean calf weight gain on the seasonlong system for lowline X calves with late birth dates was 1.98 lbs per day, 27.10 lbs per acre, accumulated pasture weight gain was 332.25 lbs, and final pasture live weight was 405.53 lbs. The net returns per cow were $307.91, per acre were $25.12, and per 640 acres were $16,076.80 (table 3). The mean calf weight gain on the seasonlong system for lowline X calves with early birth dates was 2.28 lbs per day, 30.48 lbs per acre, accumulated pasture weight gain was 373.47 lbs, and final pasture live weight was 528.24 lbs. The net returns per cow were $359.75, per acre were $29.34, and per 640 acres were $18,777.60 (table 3). The lowline X calves on the seasonlong system with early birth dates had 15.2% greater gain per day, 12.5% greater gain per acre, the accumulated pasture weight gain was 41.22 lbs (12.4%) greater, and final pasture weight was 122.71 lbs (30.3%) greater than that of the calves with late birth dates. The net returns per cow were $51.84 (16.8%) greater, per acre were $4.22 (16.8%)

greater, and per 640 acres were $2,700.80 (16.8%) greater for the calves with early birth dates than for the calves with late birth dates on the seasonlong system (table 3).

Pasture weight gains of lowline X calves with late (May) birth dates were compared to that of lowline X calves with early (March) birth dates with cows grazing spring and summer pastures of the twice-over rotation system (table 3). The mean calf weight gain on the twice-over rotation system for lowline X calves with late birth dates was 2.01 lbs per day, 29.54 lbs per acre, accumulated pasture weight gain was 337.91 lbs, and final pasture live weight was 414.01 lbs. The net returns per cow were $322.18, per acre were $28.16, and per 640 acres were $18,022.40 (table 3). The mean calf weight gain on the twice-over rotation system for lowline X calves with early birth dates was 2.36 lbs per day, 33.83 lbs per acre, accumulated pasture weight gain was 387.07 lbs, and final pasture live weight was 546.78 lbs. The net returns per cow were $383.63, per acre were $33.53, and per 640 acres were $21,459.20 (table 3). The lowline X calves on the twice-over rotation system with early birth dates had 17.4% greater gain per day, 14.5% greater gain per acre, the accumulated pasture weight gain was 49.16 lbs (14.5%) greater, and final pasture weight was 132.77 lbs (32.1%) greater than that of the calves with late birth dates. The net returns per cow were $61.45 (19.1%) greater, per acre were $5.37 (19.1%) greater, and per 640 acres were $3,436.80 (19.1%) greater for the calves with early birth dates than for the calves with late birth dates on the twice-over rotation system (table 3).

Calves born during the early (March) calving season gained greater weight and captured greater net returns than the calves born during the late (May) calving season on both the seasonlong system and the twice-over rotation system with the grazing period from early May to mid October.

The lowline X calves performed better on the twice-over rotation system than on the seasonlong system. The early born calves on the twice-over rotation system had 3.5% greater gain per day, 11.0% greater gain per acre, the accumulated weight gain was 13.6 lbs (3.6%) greater, and the final pasture weight was 18.54 lbs (3.5%) greater than that for the early born calves on the seasonlong system. The net returns after pasture costs for the early born calves on the twice-over rotation system were $23.88 (6.6%) greater per cow, $4.19 (14.3%) greater per acre, and $2,681.60 (14.3%) greater per 640 acres than that for the early born calves on the seasonlong system (table 3).

The late born calves on the twice-over rotation system had 1.5% greater gain per day, 9.0% greater gain per acre, the accumulated weight gain was 5.66 lbs (1.7%) greater, and the final pasture weight was 8.48 lbs (2.1%) greater than that for the late born calves on the seasonlong system. The net returns after pasture costs for the late born calves on the twice-over rotation system were $14.27 (4.6%) greater per cow, $3.04 (12.1%) greater per acre, and $1,945.60 (12.1%) greater per 640 acres than that for the late born calves on the seasonlong system (table 3).

Calves born during the early (March) calving season and during the late (May) calving season with cows grazing the spring and summer pastures of the twice-over rotation system gained greater weight than the calves born during the early and late calving season, respectively, with cows grazing the spring and summer pastures of the seasonlong system with the grazing period from early May to mid October.

Three Birth Date Periods Compared

The early (March) and late (May) calving seasons for the lowline X cattle were separated into three birth date categories. The early calving season birth dates were separated into the 1st period, 1 March to 15 March, 2nd period, 16 March to 30 March, and 3rd period, 31 March to 19 April. The late calving season birth dates were separated into the 1st period, 1 May to 16 May, 2nd period, 17 May to 31 May, and 3rd period, 1 June to 23 June. The calf weight gain performance generally declined from the calves with birth dates during the 1st period down to the calves with birth dates during the 3rd period.

The pounds of weight gain by lowline X calves born the 1st, 2nd, and 3rd periods of the early (March) calving season were compared to the pounds of weight gain by calves born during the 1st, 2nd, and 3rd periods of the late (May) calving season, respectively, on the crested wheatgrass pastures and on the native rangeland pastures of the seasonlong system (table 4). The early calving season calves born during the 1st period gained 11.35 lbs (24.8%) greater, calves born during the 2nd period gained 24.13 lbs (80.6%) greater, and calves born during the 3rd period gained 32.13 lbs (425.6%) greater than the late calving season calves born during the 1st, 2nd, and 3rd periods, respectively, on the crested wheatgrass pastures of the seasonlong system (table 4). The early calving season calves born during the 1st period gained 21.05 lbs (7.0%) greater, calves born during the 2nd period gained 14.57 lbs (4.7%) greater, and calves born during the 3rd period gained 33.60 lbs (11.6%) greater than the late calving season calves born during the 1st, 2nd, and 3rd periods, respectively, on the native rangeland pastures of the seasonlong system (table 4).

The pounds of weight gain by lowline X calves born the 1st, 2nd, and 3rd periods of the early (March) calving season were compared to the pounds of weight gain by calves born during the 1st, 2nd, and 3rd periods of the late (May) calving season, respectively, on the crested wheatgrass pastures and on the native rangeland pastures of the twice-over rotation system (table 4). The early calving season calves born during the 1st period gained 4.70 lbs (7.7%) less, calves born during the 2nd period gained 21.74 lbs (67.8%) greater, and calves born during the 3rd period gained 28.66 lbs (121.5%) greater than the late calving season calves born during the 1st, 2nd, and 3rd periods, respectively, on the crested wheatgrass pastures of the twice-over rotation system (table 4). The early calving season calves born during the 1st period gained 22.52 lbs (7.4%) greater, calves born during the 2nd period gained 32.47 lbs (10.5%) greater, and calves born during the 3rd period gained 24.48 lbs (8.1%) greater than the late calving season calves born during the 1st, 2nd, and 3rd periods, respectively, on the native rangeland pastures of the twice-over rotation system (table 4).

The weight gains of lowline X calves with early (March) birth dates during the 1st period were compared to the weight gains of calves born during the 2nd period on the seasonlong system (table 5). The calves born during the 1st period had 0.9% greater gain per day, 1.2% greater gain per acre, the accumulated weight gain was 4.37 lbs (1.2%) greater, and the final pasture weight was 30.35 lbs (5.8%) greater than that for the calves born during the 2nd period. The net returns for the calves born during the 1st period were $5.47 (1.5%) greater per cow, $0.45 (1.5%) greater per acre, and $288.00 (1.5%) greater per 640 acres than that for the calves born during the 2nd period on the seasonlong system (table 5).

The weight gains of lowline X calves with early (March) birth dates during the 1st period were compared to the weight gains of calves born during the 3rd period on the seasonlong system (table 5). The calves born during the 1st period had 4.5% greater gain per day, 4.7% greater gain per acre, the accumulated weight gain was 17.17 lbs (4.7%) greater, and the final pasture weight was 53.94 lbs (10.8%) greater than that for the calves born during the 3rd period. The net returns for the calves born during the 1st period were $21.74 (6.2%) greater per cow, $1.76 (6.2%) greater per acre, and $1,126.40 (6.2%) greater per 640 acres than that for the calves born during the 3rd period on the seasonlong system (table 5).

The weight gains of lowline X calves with early (March) birth dates during the 2nd period were compared to the weight gains of calves born during the 3rd period on the seasonlong system (table 5). The calves born during the 2nd period had 4.5% greater gain per day, 3.5% greater gain per acre, the accumulated weight gain was 12.80 lbs (3.5%) greater, and the final pasture weight was 23.59 lbs (4.7%) greater than that for the calves born during the 3rd period. The net returns for the calves born during the 2nd period were $16.00 (4.6%) greater per cow, $1.31 (4.6%) greater per acre, and $838.40 (4.6%) greater per 640 acres than that for the calves born during the 3rd period on the seasonlong system (table 5).

The weight gains of lowline X calves with late (May) birth dates during the 1st period were compared to the weight gains of calves born during the 2nd period on the seasonlong system (table 6). The calves born during the 1st period had 3.0% greater gain per day, 3.2% greater gain per acre, the accumulated weight gain was 10.68 lbs (3.2%) greater, and the final pasture weight was 8.13 lbs (2.0%) greater than that for the calves born during the 2nd period. The net returns for the calves born during the 1st period were $13.35 (4.2%) greater per cow, $1.09 (4.2%) greater per acre, and $697.60 (4.2%) greater per 640 acres than that for the calves born during the 2nd period on the seasonlong system (table 6).

The weight gains of lowline X calves with late (May) birth dates during the 1st period were compared to the weight gains of calves born during the 3rd period on the seasonlong system (table 6). The calves born during the 1st period had 16.9% greater gain per day, 16.9% greater gain per acre, the accumulated weight gain was 50.50 lbs (16.9%) greater, and the final pasture weight was 43.50 lbs (11.5%) greater than that for the calves born during the 3rd period. The net returns for the calves born during the 1st period were $63.13 (23.8%) greater per cow, $5.15 (23.8%) greater per acre, and $3,296.00 (23.8%) greater per 640 acres than that for the calves born during the 3rd period on the seasonlong system (table 6).

The weight gains of lowline X calves with late (May) birth dates during the 2nd period were compared to the weight gains of calves born during the 3rd period on the seasonlong system (table 6). The calves born during the 2nd period had 13.6% greater gain per day, 13.3% greater gain per acre, the accumulated weight gain was 39.82 lbs (13.4%) greater, and the final pasture weight was 35.37 lbs (9.4%) greater than that for the calves born during the 3rd period. The net returns for the calves born during the 2nd period were $49.78 (18.8%) greater per cow, $4.06 (18.8%) greater per acre, and $2,598.40 (18.8%) greater per 640 acres than that for the calves born during the 3rd period on the seasonlong system (table 6).

The weight gains of lowline X calves with early (March) birth dates during the 2nd period were compared to the weight gains of calves born during the 1st period on the twice-over rotation system (table 7). The calf weight gains were greater during the 2nd period than during the 1st period because the nutrient quality of the forage delivered in the lactation ration to the cows for the first couple of weeks during the 1st period of calving was below the nutrient requirements during both 2010 and 2011. The calves born during the 2nd period had 3.4% greater gain per day, 3.1% greater gain per acre, the accumulated weight gain was 11.89 lbs (3.1%) greater, and the final pasture weight was 8.0 lbs (1.4%) greater than that for the calves born during the 1st period. The net returns for the calves born during the 2nd period were $14.86 (3.9%) greater per cow, $1.30 (3.9%) greater per acre, and $832.00 (3.9%) greater per 640 acres than that for the calves born during the 1st period on the twice-over rotation system (table 7).

The weight gain of lowline X calves with early (March) birth dates during the 2nd period were compared to the weight gains of the calves born during the 3rd period on the twice-over rotation system (table 7). The calves born during the 2nd period had 4.3% greater gain per day, 4.3% greater gain per acre, the accumulated weight gain was 16.37 lbs (4.3%) greater, and the final pasture weight was 57.69 lbs (11.4%) greater than that for the calves born during the 3rd period. The net returns for the calves born during the 2nd period were $20.46 (5.5%) greater per cow, $1.79 (5.5%) greater per acre, and $1,195.60 (5.5%) greater per 640 acres than that for the calves born during the 3rd period on the twice-over rotation system (table 7).

The weight gains of lowline X calves with early (March) birth dates during the 1st period were compared to the weight gains of calves born during the 3rd period on the twice-over rotation system (table 7). The calves born during the 1st period had 0.9% greater gain per day, 1.2% greater gain per acre, the accumulated weight gain was 4.48 lbs (1.2%) greater, and the final pasture weight was 49.69 lbs (9.8%) greater than that for the calves born during the 3rd period. The net returns for the calves born during the 1st period were $5.60 (1.5%) greater per cow, $0.49 (1.5%) greater per acre, and $313.60 (1.5%) greater per 640 acres than that for the calves born during the 3rd period on the twice-over rotation system (table 7).

The weight gains of lowline X calves with late (May) birth dates during the 1st period were compared to the weight gains of calves born during the 2nd period on the twice-over rotation system (table 8). The calves born during the 1st period had 7.4% greater gain per day, 7.2% greater gain per acre, the accumulated weight gain was 24.50 lbs (7.2%) greater, and the final pasture weight was 16.65 lbs (4.0%) greater than that for the calves born during the 2nd period. The net returns for the calves born during the 1st period were $30.62 (9.4%) greater per cow, $2.67 (9.3%) greater per acre, and $1,708.80 (9.3%) greater per 640 acres than that for the calves born during the 2nd period on the twice-over rotation system (table 8).

The weight gains of lowline X calves with late (May) birth dates during the 1st period were compared to the weight gains of calves born during the 3rd period on the twice-over rotation system (table 8). The calves born during the 1st period had 12.4% greater gain per day, 12.4% greater gain per acre, the accumulated weight gain was 39.80 lbs (12.2%) greater, and the final pasture weight was 69.14 lbs (18.8%) greater than that for the calves born during the 3rd period. The net returns for the calves born during the 1st period were $49.75 (16.2%) greater per cow, $4.35 (16.2%) greater per acre, and $2,784.00 (16.2%) greater per 640 acres than that for the calves born during the 3rd period on the twice-over rotation system (table 8).

The weight gains of lowline X calves with late (May) birth dates during the 2nd period were compared to the weight gains of calves born during the 3rd period on the twice-over rotation system (table 8). The calves born during the 2nd period had 4.6% greater gain per day, 4.7% greater gain per acre, the accumulated weight gain was 15.30 lbs (4.7%) greater, and the final pasture weight was 52.49 lbs (14.3%) greater than that for the calves born during the 3rd period. The net returns for the calves born during the 2nd period were $19.13 (6.2%) greater per cow, $1.68 (6.2%) greater per acre, and $1,075.20 (6.2%) greater than that for the calves born during the 3rd period on the twice-over rotation system (table 8).

Calves born during the 1st period of a calving season gained greater weight and captured greater net returns than the calves born during the 2nd period, and calves born during the 3rd period gained much less weight and captured less net returns than the calves born during the 1st and 2nd periods of both the early and late calving seasons.

The weight gains of lowline X calves born during the 1st period of the early (March) calving season were compared to the weight gains of calves born during the 1st period of the late (May) calving season on the seasonlong system (tables 5 and 6). The calves born during the 1st period of the early calving season had 12.1% greater gain per day, 9.3% greater gain per acre, the accumulated weight gain was 32.40 lbs (9.3%) greater, and the final pasture weight was 134.28 lbs (31.9%) greater than that for the calves born during the 1st period of the late calving season. The net returns for the calves born during the 1st period of the early calving season were $40.50 (12.3%) greater per cow, $3.31 (12.4%) greater per acre, and $2,118.40 (12.4%) greater per 640 acres than that for the calves born during the 1st period of the late calving season on the seasonlong system (tables 5 and 6).

The weight gains of lowline X calves born during the 2nd period of the early (March) calving season were compared to the weight gains of calves born during the 2nd period of the late (May) calving season on the seasonlong system (tables 5 and 6). The calves born during the 2nd period of the early calving season had 14.4% greater gain per day, 11.5% greater gain per acre, the accumulated weight gain was 38.70 lbs (11.5%) greater, and the final pasture weight was 112.06 lbs (27.2%) greater than that for the calves born during the 2nd period of the late calving season. The net returns for the calves born during the 2nd period of the early calving season were $48.38 (15.4%) greater per cow, $3.95 (15.4%) greater per acre, and $2,528.00 (15.4%) greater per 640 acres than that for the calves born during the 2nd period of the late calving season on the seasonlong system (tables 5 and 6).

The weight gains of lowline X calves born during the 3rd period of the early (March) calving season were compared to the weight gains of calves born during the 3rd period of the late (May) calving season on the seasonlong system (tables 5 and 6). The calves born during the 3rd period of the early calving season had 25.4% greater gain per day, 22.1% greater gain per acre, the accumulated weight gain was 65.73 lbs (22.1%) greater, and the final pasture weight was 123.84 lbs (32.8%) greater than that for the calves born during the 3rd period of the late calving season. The net returns for the calves born during the 3rd period of the early calving season were $82.16 (31.0%) greater per cow, $6.70 (31.0%) greater per acre, and $4,288.00 (31.0%) greater per 640 acres than that for the calves born during the 3rd period of the late calving season on the seasonlong system (tables 5 and 6).

The weight gains of lowline X calves born during the 1st period of the early (March) calving season were compared to the weight gains of calves born during the 1st period of the late (May) calving season on the twice-over rotation system (tables 7 and 8). The calves born during the 1st period of the early calving season had 7.3% greater gain per day, 4.9% greater gain per acre, the accumulated weight gain was 17.82 lbs (4.9%) greater, and the final pasture weight was 119.88 lbs (27.5%) greater than that for the calves born during the 1st period of the late calving season. The net returns for the calves born during the 1st period of the early calving season were $22.28 (6.2%) greater per cow, $1.95 (6.2%) greater per acre, and $1,248.00 (6.2%) greater per 640 acres than that for the calves born during the 1st period of the late calving season on the twice-over rotation system (tables 7 and 8).

The weight gains of lowline X calves born during the 2nd period of the early (March) calving season were compared to the weight gains of calves born during the 2nd period of the late (May) calving season on the twice-over rotation system (tables 7 and 8). The calves born during the 2nd period of the early calving season had 19.2% greater gain per day, 15.9% greater gain per acre, the accumulated weight gain was 54.21 lbs (15.9%) greater, and the final pasture weight was 144.53 lbs (34.5%) greater than that for the calves born during the 2nd period of the late calving season. The net returns for the calves born during the 2nd period of the early calving season were $67.76 (20.7%) greater per cow, $5.92 (20.7%) greater per acre, and $3,788.80 (20.7%) greater per 640 acres than that for the calves born during the 2nd period of the late calving season on the twice-over rotation system (tables 7 and 8).

The weight gains of lowline X calves born during the 3rd period of the early (March) calving season were compared to the weight gains of calves born during the 3rd period of the late (May) calving season on the twice-over rotation system (tables 7 and 8). The calves born during the 3rd period of the early calving season had 19.6% greater gain per day, 12.3% greater gain per acre, the accumulated weight gain was 53.14 lbs (16.3%) greater, and the final pasture weight was 139.33 lbs (38.0%) greater than that for the calves born during the 3rd period of the late calving season. The net returns for the calves born during the 3rd period of the early calving season were $66.43 (21.6%) greater per cow, $5.81 (21.6%) greater per acre, and $2,918.40 (16.2%) greater per 640 acres than that for the calves born during the 3rd period of the late calving season on the twice-over rotation system (tables 7 and 8).

Calves born during the 1st, 2nd, and 3rd periods of the early (March) calving season gained greater weight and captured greater net returns than the calves born during the 1st, 2nd, and 3rd periods of the late (May) calving season, respectively, on both the seasonlong system and on the twice-over rotation system.

Match vs. Mismatch Forage Nutrients

The nutrient requirements of the lowline X cows and calves with early (March) birth dates during the 1st and 2nd periods closely matched the available forage nutrients until early August on the crested wheatgrass and native rangeland pastures of the seasonlong system. The nutrient requirements of the lowline X cows and calves with late (May) birth dates during the 2nd and 3rd periods mismatched the available forage nutrients on the crested wheatgrass and native rangeland pastures of the seasonlong system. The weight gains of calves with late (May) birth dates during the 2nd and 3rd periods were compared to the weight gains of calves with early (March) birth dates during the 1st and 2nd periods on the seasonlong system (table 9). Calves with early birth dates during the 1st and 2nd periods had 22.2% greater gain per day, 19.1% greater gain per acre, the accumulated weight gain was 60.81 lbs (19.1%) greater, and the final pasture weight was 144.92 lbs (36.7%) greater than that for the calves with late birth dates during the 2nd and 3rd periods. The net returns for the calves with early birth dates during the 1st and 2nd periods were $76.01 (26.2%) greater per cow, $6.20 (26.2%) greater per acre, and $3,968.00 (26.2%) greater per 640 acres than that for the calves with late birth dates during the 2nd and 3rd periods on the seasonlong system (table 9).

The poor animal performance of the lowline X cows and calves with late birth dates during the 2nd and 3rd periods on the seasonlong system reduced the accumulated calf weight gain 60.81 pounds and reduced the final pasture weight 144.92 pounds and reduced the net returns after pasture costs $6.20 per acre and $76.01 per cow compared to the good animal performance of the lowline X cows and calves with early birth dates during the 1st and 2nd periods. With a one hundred cow herd, the herd net returns after pasture costs would be $36,600.00 for the calves with early birth dates during the 1st and 2nd periods and would be $28,999.00 for the calves with late birth dates during the 2nd and 3rd periods resulting in a loss of $7,601.00 for the herd with late birth dates during the 2nd and 3rd periods on the seasonlong system.

The nutrient requirements of the lowline X cows and calves with early (March) birth dates during the 1st and 2nd periods matched the available forage nutrients on the crested wheatgrass and native rangeland pastures of the twice-over rotation system. The nutrient requirements of the lowline X cows and calves with late (May) birth dates during the 2nd and 3rd periods mismatched the available forage nutrients on the crested wheatgrass and native rangeland pastures of the twice-over rotation system. The weight gains of calves with late (May) birth dates during the 2nd and 3rd periods were compared to the weight gains of the calves with early (March) birth dates during the 1st and 2nd periods on the twice-over rotation system (table 9). Calves with early birth dates during the 1st and 2nd periods had 19.6% greater gain per day, 16.7% greater gain per acre, the accumulated weight gain was 55.92 lbs (16.7%) greater, and the final pasture weight was 166.77 lbs (42.4%) greater than that for the calves with late birth dates during the 2nd and 3rd periods. The net returns for the calves with early birth dates during the 1st and 2nd periods were $69.90 (22.0%) greater per cow, $6.23 (22.5%) greater per acre, and $3,987.20 (22.5%) greater per 640 acres than that for the calves with late birth dates during the 2nd and 3rd periods on the twice-over rotation system (table 9).

The poor animal performance of the lowline X cows and calves with late birth dates during the 2nd and 3rd periods on the twice-over rotation system reduced the accumulated calf weight gain 55.92 pounds and reduced the final pasture weight 166.77 pounds and reduced the net returns after pasture costs $6.23 per acre and $69.90 per cow compared to the good animal performance of the lowline X cows and calves with early birth dates during the 1st and 2nd periods. With a one hundred cow herd, the herd net returns after pasture costs would be $38,737.00 for the calves with early birth dates during the 1st and 2nd periods and would be $31,747.00 for the calves with late birth dates during the 2nd and 3rd periods resulting in a loss of $6,990.00 for the herd with late birth dates during the 2nd and 3rd periods on the twice-over rotation system.

The lowline X cows and calves with early birth dates during the 1st and 2nd periods performed well. The calves with early birth dates during the 1st and 2nd periods were older than one month of age at the start of grazing the crested wheatgrass pastures in early May. The cows were able to produce milk at or near their genetic potential levels and the early born calves were able to accumulate weight at or near their genetic potential rates.

The lowline X cows and calves with late birth dates during the 2nd and 3rd periods performed poorly. The cows were not permitted to take advantage of the high nutritional quality of crested wheatgrass during May resulting in milk production below the genetic potentials of the cows. The reduction in milk production resulted in calf accumulation of weight at below the genetic potential rates.

Discussion

Most wild ungulates in the Northern Plains give birth to the next generation during May each year. The herd population increases if 25% of the mature females wean a live offspring. The primary survival strategy of wild ungulates does not include providing large quantities of nutritious meat to carnivores. Livestock husbandry practices designed to emulate the production model of wild ungulates moves the livestock production periods and nutrient requirement curves out of synchronization with the perennial forage nutrient available curves.

The nutrient requirements for beef cows above maintenance levels varies with the changes in nutrient demand for milk production for the nursing calf as it grows, and with the changes in nutrient demand of the physiological preparation for breeding and the development of the fetus that will be the next calf (BCRC 1999, Manske 2002, Manske and Schneider 2007).

The available nutritional quality curves of perennial forage grasses are determined by changes in day length (photoperiod) and cannot be changed (Manske 2008a, 2008b, 2011a, 2011b). Crude protein levels of domesticated cool season grasses (crested wheatgrass and smooth bromegrass) are closely related to the phenological stages of growth and development, which are triggered primarily by the length of daylight. Domesticated cool season grasses develop earlier than native cool season grasses. Domesticated cool season grasses are physiologically ready for grazing by early May with adequate quantities of herbage biomass and with most of the lead tillers at or past the 3.5 new leaf stage. Lead tillers contain the highest levels of crude protein during the early stages of development at 16% to 19% during early to mid May. Domesticated grasses are long day plants and the lead tillers reach the flower phenological stage around 28 May. Crude protein levels remain above 9.6% at flower stage but decrease rapidly during seed development stage, dropping below 9.6% soon after mid June, below 7.5% by early July, and below 6.4% by mid July (Whitman et al. 1951, Manske 2008a). Phosphorus levels of lead tillers drop below 0.18% in late July, when plants reach the mature seed stage (Whitman et al. 1951, Manske 2008b).

Crude protein levels of cool season native range grasses are closely related to the phenological stages of growth and development, which are triggered primarily by the length of daylight. The length of daylight increases during the growing season between mid April and mid June (21 June) and then decreases. Lead tillers contain the highest levels of crude protein during the early stages of development. Cool season grasses are long day plants and the lead tillers usually reach the flower phenological stage before 21 June. Crude protein levels remain above 9.6% at flower stage but decrease rapidly during seed development and seed mature stages, dropping below 7.8% by early August and below 6.2% in late August (Whitman et al. 1951, Manske 2008a). Secondary tillers are stimulated to develop on the twice-over rotation system, however, they are not stimulated to grow on the seasonlong system. Crude protein levels of cool season secondary tillers increase above 9.6% during July and August to 13.2% in early September, decrease during September, and drop below 9.6% in early to mid October (Sedivec 1999, Manske 2008a). Phosphorus levels of lead tillers drop below 0.18% in late July, when plants reach the mature seed stage (Whitman et al. 1951, Manske 2008b).

Crude protein levels of warm season native range grasses are closely related to the phenological stages of growth and development, which are triggered primarily by the length of daylight. Lead tillers contain the highest levels of crude protein during the early stages of development. Warm season grasses are short day plants and the lead tillers usually reach the flower phenological stage after 21 June. Crude protein levels remain above 9.6% at flower stage but decrease rapidly during seed development and seed mature stages, dropping below 9.6% in late July, and below 6.2% in early September (Whitman et al. 1951, Manske 2008a). Secondary tillers are stimulated to develop on the twice-over rotation system, however, they are not stimulated to grow on the seasonlong system. Crude protein levels of warm season secondary tillers increase above 9.0% during August to 10.0% in early September, decrease during September, and drop below 9.6% in late September (Sedivec 1999, Manske 2008a). Phosphorus levels of lead tillers drop below 0.18% in late August, when plants reach the mature seed stage (Whitman et al. 1951, Manske 2008b).

Crude protein levels of upland sedges do not follow the same relationships with phenological growth stages as do the crude protein levels of cool and warm season grasses. Upland sedges contain the highest levels of crude protein during the early stages of development. Crude protein levels remain high through flower and seed mature stages and decrease with increases in senescence. Upland sedges grow very early and produce seed heads in late April to early May. Crude protein levels remain above 9.6% after seed mature stage, until mid July. Crude protein levels decrease below 7.8% in early August but do not fall below 6.2% for the remainder of the growing season (Whitman et al. 1951, Manske 2008a). Phosphorus levels drop below 0.18% in mid May, when plants reach the mature seed stage (Whitman et al. 1951, Manske 2008b).

The time of year during which the cow production periods with different nutritional requirements occur can be changed and synchronized with the nutritional quality curves of the perennial grasses by rationally setting the calving date which is determined by the breeding date. The greatest synchronization of the beef cow nutrient requirement curves and the perennial forage grass nutrient available curves occurs when the young calves are one month old at the start of grazing in early May on complementary domesticated cool season grass pastures (Manske 2002, Manske 2011b, Manske and Schneider 2008c).

The original source of new wealth generated from livestock agriculture are the renewable forage nutrients produced by perennial grasses. Greater calf weight gain is accumulated per acre when greater quantities of crude protein are captured per acre. The calf weight is the commodity sold at market, nevertheless, the source of the beef weight sold is the forage nutrients. Increasing the quantity of wealth captured from the land natural resources requires capturing greater quantities of the produced crude protein from the perennial forage grasses. Capturing greater quantities of crude protein per acre requires that the beef cow production periods and her nutrient requirement curves be in harmonious synchronization with the available nutrient curves of the perennial grasses (Manske and Schneider 2007), which requires the beef calves to be born before early April.

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Table 1. Precipitation in inches for growing season months of 2010-2013, DREC Ranch, North Dakota.

	Apr	May	Jun	Jul	Aug	Sep	Oct	Growing Season
Long-term mean	1.41	2.60	3.24	2.44	1.73	1.46	1.28	14.15
2010	1.43	3.70	3.50	1.94	1.39	4.09	0.13	16.18
% of LTM	101.42	142.31	108.02	79.51	80.35	280.14	10.16	114.35
2011	1.66	6.87	2.15	2.33	2.70	1.76	0.44	17.91
% of LTM	117.73	264.23	66.36	95.49	156.07	120.55	34.38	126.57
2012	2.38	1.58	4.31	1.98	0.82	0.21	2.35	13.63
% of LTM	168.79	60.77	133.02	81.15	47.40	14.38	183.59	96.33
2013	1.05	7.55	2.23	2.13	2.81	2.44	3.35	21.56
% of LTM	74.47	290.38	68.83	87.30	162.43	167.12	261.72	152.37
Mean	1.63	4.93	3.05	2.10	1.93	2.13	1.57	17.32
% of LTM	115.60	189.42	94.06	85.86	111.56	145.55	122.46	122.40

Table 2. Running total precipitation in inches for growing season months of 2010-2013, DREC Ranch, North Dakota.

	Apr	May	Jun	Jul	Aug	Sep	Oct
Long-term mean 1982-2011	1.41	4.01	7.25	9.69	11.42	12.88	14.15
2010	1.43	5.13	8.63	10.57	11.96	16.05	16.18
% of LTM	101.42	127.93	119.03	109.08	104.73	124.61	114.35
2011	1.66	8.53	10.68	13.01	15.71	17.47	17.91
% of LTM	117.73	212.72	147.31	134.26	137.57	135.64	126.57
2012	2.38	3.96	8.27	10.25	11.07	11.28	13.63
% of LTM	168.79	98.75	114.07	105.78	96.94	87.58	96.33
2013	1.05	8.60	10.83	12.96	15.77	18.21	21.56
% of LTM	74.47	214.46	149.38	133.75	138.09	141.38	152.37
Mean	1.63	6.56	9.60	11.70	13.63	15.75	17.32
% of LTM	115.60	163.47	132.45	120.72	119.33	122.30	122.40

Table 3. Weight gain, costs, and net returns for lowline X calves with early and late birth date categories grazing spring and summer twice-over rotation and seasonlong system pastures, from early May to mid October.

		Twice-over Rotation		Seasonlong	
Calf Birth Date Categories		Early Birth	Late Birth	Early Birth	Late Birth
Birth Date		18 Mar	24 May	17 Mar	26 May
Birth Weight	lbs	72.3	76.1	69.5	73.3
Land Rent	$	8.76	8.76	8.76	8.76
Land Area	ac	11.44	11.44	12.26	12.26
Forage Costs	$	100.21	100.21	107.40	107.40
Days on Pasture		164.00	168.00	164.00	168.00
Cost/Day	$	0.61	0.60	0.65	0.64
Calf Wt					
Pasture Gain	lbs	387.07	337.91	373.47	332.25
Gain/Day	lbs	2.36	2.01	2.28	1.98
Gain/Acre	lbs	33.83	29.54	30.48	27.10
Wt Value@$1.25/lb		483.84	422.39	467.15	415.31
Net Return/Cow	$	383.63	322.18	359.75	307.91
Net Return/Acre	$	33.53	28.16	29.34	25.12
Cost/lb Gain	$	0.26	0.30	0.29	0.32
Weaning Wt	lbs	546.78	414.01	528.24	405.53
% Cow Wt		51.7	37.0	48.8	36.0
C-Cprs/640 ac		56	56	52	52
Net Return/640 ac	$	21,459.20	18,022.40	18,777.60	16,076.80

Table 4. Pounds of weight gain on crested wheatgrass and native rangeland pastures on the seasonlong and twice-over rotation systems for lowline X calves born during the 1st, 2nd, and 3rd periods of the early and late calving seasons.

Grazing Systems Early and Late Calving Seasons 1st, 2nd, and 3rd Periods	Birth Date	Birth Wt	Live Weight Gain Crested Wheatgrass	Native Rangeland	Total Season	Final Pasture Weight
Seasonlong 2010-2011	early (March) calving season					
Early 1st Period	6 Mar	70.6	57.10	323.80	380.90	554.78
Mid 2nd Period	20 Mar	69.1	54.07	322.45	376.53	524.43
Late 3rd Period	5 Apr	71.6	39.68	324.05	363.73	500.84
2012-2013	late (May) calving season					
Early 1st Period	17 May	72.0	45.75	302.75	348.50	420.50
Mid 2nd Period	24 May	74.6	29.94	307.88	337.82	412.37
Late 3rd Period	6 Jun	71.1	7.55	290.45	298.00	377.00
Twice-over Rotation 2010-2011	early (March) calving season					
Early 1st Period	6 Mar	71.1	56.57	327.54	384.11	556.02
Mid 2nd Period	20 Mar	73.9	53.82	342.18	396.00	564.02
Late 3rd Period	4 Apr	72.6	52.25	327.38	379.63	506.33
2012-2013	late (May) calving season					
Early 1st Period	10 May	69.9	61.27	305.02	366.29	436.14
Mid 2nd Period	23 May	77.7	32.08	309.71	341.79	419.49
Late 3rd Period	8 Jun	78.1	23.59	302.90	326.49	367.00

Table 5. Weight gain, costs, and net returns for lowline X calves with three early birth date categories grazing spring and summer seasonlong system pastures, from early May to mid October.

Calf Birth Dates 2010-2011		1st Period 1 Mar to 15 Mar (15 days)	2nd Period 16 Mar to 30 Mar (15 days)	3rd Period 31 Mar to 19 Apr (20 days)	Calving Season 01 Mar to 19 Apr (50 days)
Birth Date		6 Mar	20 Mar	5 Apr	17 Mar
Birth Weight	lbs	70.6	69.1	71.6	69.5
Land Rent	$	8.76	8.76	8.76	8.76
Land Area	ac	12.26	12.26	12.26	12.26
Forage Costs	$	107.40	107.40	107.40	107.40
Days on Pasture		164.00	164.00	164.00	164.00
Cost/Day	$	0.65	0.65	0.65	0.65
Calf Wt					
Pasture Gain	lbs	380.90	376.53	363.73	373.47
Gain/Day	lbs	2.32	2.30	2.22	2.28
Gain/Acre	lbs	31.07	30.71	29.67	30.48
Wt Value@$1.25/lb		476.13	470.66	454.66	467.15
Net Return/Cow	$	368.73	363.26	347.26	359.75
Net Return/Acre	$	30.08	29.63	28.32	29.34
Cost/lb Gain	$	0.28	0.29	0.30	0.29
Weaning Wt	lbs	554.78	524.43	500.84	528.24
% Cow Wt		51.3	48.5	46.3	48.8
C-Cprs/640 ac		52	52	52	52
Net Return/640 ac	$	19,251.20	18,963.20	18,124.80	18,777.60

Table 6. Weight gain, costs, and net returns for lowline X calves with three late birth date categories grazing spring and summer seasonlong system pastures, from early May to mid October.

Calf Birth Dates 2012-2013		1st Period 1 May to 16 May (16 days)	2nd Period 17 May to 31 May (15 days)	3rd Period 1 Jun to 23 Jun (23 days)	Calving Season 01 May to 23 Jun (54 days)
Birth Date		17 May	24 May	6 Jun	26 May
Birth Weight	lbs	72.0	74.6	71.1	73.3
Land Rent	$	8.76	8.76	8.76	8.76
Land Area	ac	12.26	12.26	12.26	12.26
Forage Costs	$	107.40	107.40	107.40	107.40
Days on Pasture		168.00	168.00	168.00	168.00
Cost/Day	$	0.64	0.64	0.64	0.64
Calf Wt					
Pasture Gain	lbs	348.50	337.82	298.00	332.25
Gain/Day	lbs	2.07	2.01	1.77	1.98
Gain/Acre	lbs	28.43	27.55	24.31	27.10
Wt Value@$1.25/lb		435.63	422.28	372.50	415.31
Net Return/Cow	$	328.23	314.88	265.10	307.91
Net Return/Acre	$	26.77	25.68	21.62	25.12
Cost/lb Gain	$	0.31	0.32	0.36	0.32
Weaning Wt	lbs	420.50	412.37	377.00	405.53
% Cow Wt		37.3	36.6	33.4	36.0
C-Cprs/640 ac		52	52	52	52
Net Return/640 ac	$	17,132.80	16,435.20	13,836.80	16,076.80

Table 7. Weight gain, costs, and net returns for lowline X calves with three early birth date categories grazing spring and summer twice-over rotation system pastures, from early May to mid October.

Calf Birth Dates 2010-2011		1st Period 1 Mar to 15 Mar (15 days)	2nd Period 16 Mar to 30 Mar (15 days)	3rd Period 31 Mar to 19 Apr (20 days)	Calving Season 01 Mar to 19 Apr (50 days)
Birth Date		6 Mar	20 Mar	4 Apr	18 Mar
Birth Weight	lbs	71.1	73.9	72.6	72.3
Land Rent	$	8.76	8.76	8.76	8.76
Land Area	ac	11.44	11.44	11.44	11.44
Forage Costs	$	100.21	100.21	100.21	100.21
Days on Pasture		164.00	164.00	164.00	164.00
Cost/Day	$	0.61	0.61	0.61	0.61
Calf Wt					
Pasture Gain	lbs	384.11	396.00	379.63	387.07
Gain/Day	lbs	2.34	2.42	2.32	2.36
Gain/Acre	lbs	33.58	34.62	33.18	33.83
Wt Value@$1.25/lb		480.14	495.00	474.54	483.84
Net Return/Cow	$	379.93	394.79	374.33	383.63
Net Return/Acre	$	33.21	34.51	32.72	33.53
Cost/lb Gain	$	0.26	0.25	0.26	0.26
Weaning Wt	lbs	556.02	564.02	506.33	546.78
% Cow Wt		52.6	53.3	47.9	51.7
C-Cprs/640 ac		56	56	56	56
Net Return/640 ac	$	21,254.40	22,086.40	20,940.80	21,459.20

Table 8. Weight gain, costs, and net returns for lowline X calves with three late birth date categories grazing spring and summer twice-over rotation system pastures, from early May to mid October.

Calf Birth Dates 2012-2013		1st Period 1 May to 16 May (16 days)	2nd Period 17 May to 31 May (15 days)	3rd Period 1 Jun to 23 Jun (23 days)	Calving Season 01 May to 23 Jun (54 days)
Birth Date		10 May	23 May	8 Jun	24 May
Birth Weight	lbs	69.9	77.7	78.1	76.1
Land Rent	$	8.76	8.76	8.76	8.76
Land Area	ac	11.44	11.44	11.44	11.44
Forage Costs	$	100.21	100.21	100.21	100.21
Days on Pasture		168.00	168.00	168.00	168.00
Cost/Day	$	0.60	0.60	0.60	0.60
Calf Wt					
Pasture Gain	lbs	366.29	341.79	326.49	337.91
Gain/Day	lbs	2.18	2.03	1.94	2.01
Gain/Acre	lbs	32.02	29.88	28.54	29.54
Wt Value@$1.25/lb		457.86	427.24	408.11	422.39
Net Return/Cow	$	357.65	327.03	307.90	322.18
Net Return/Acre	$	31.26	28.59	26.91	28.16
Cost/lb Gain	$	0.27	0.29	0.31	0.30
Weaning Wt	lbs	436.14	419.49	367.00	414.01
% Cow Wt		39.0	37.5	32.8	37.0
C-Cprs/640 ac		56	56	56	56
Net Return/640 ac	$	20,006.40	18,297.60	17,222.40	18,022.40

Table 9. Weight gain, costs, and net returns for lowline X calves with early and late birth date categories grazing spring and summer twice-over rotation and seasonlong system pastures, from early May to mid October.

		Twice-over Rotation		Seasonlong	
Calf Birth Dates		Early Birth 1st and 2nd Periods	Late Birth 2nd and 3rd Periods	Early Birth 1st and 2nd Periods	Late Birth 2nd and 3rd Periods
Birth Date		13 Mar	30 May	13 Mar	30 May
Birth Weight	lbs	72.5	77.9	69.9	72.9
Land Rent	$	8.76	8.76	8.76	8.76
Land Area	ac	11.44	11.44	12.26	12.26
Forage Costs	$	100.21	100.21	107.40	107.40
Days on Pasture		164.00	168.00	164.00	168.00
Cost/Day	$	0.61	0.60	0.65	0.64
Calf Wt					
Pasture Gain	lbs	390.06	334.14	378.72	317.91
Gain/Day	lbs	2.38	1.99	2.31	1.89
Gain/Acre	lbs	34.10	29.21	30.89	25.93
Wt Value@$1.25/lb		487.58	417.68	473.40	397.39
Net Return/Cow	$	387.37	317.47	366.00	289.99
Net Return/Acre	$	33.98	27.75	29.85	23.65
Cost/lb Gain	$	0.26	0.30	0.28	0.34
Weaning Wt	lbs	560.02	393.25	539.61	394.69
% Cow Wt		52.9	35.1	49.9	35.0
C-Cprs/640 ac		56	56	52	52
Net Return/640 ac	$	21,747.20	17,760.00	19,104.00	15,136.00

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