GROWTH PATTERNS OF RANGE BEEF CALVES OVER DISCRETE PREWEANING INTERVALS

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Suckling range beef calf production demonstrates periodicity despite consistency of management. Performance of calves within 33- to 50-d intervals from birth to weaning over nine seasons demonstrated maximum interval growth of approximately 1 kg d^{-1}, but average seasonal growth rates varied from 0.79 to 0.99 kg d^{-1}. Maximizing available forages for the final 33 d preweaning could minimize seasonal variations in calf production.

Key words: Calf production, liveweight gain, rangelands

[Croissance des veaux de boucherie élevés en parcours pendant des intervalles discrets précédant le sevrage]
Titre abrégé: Croissance des veaux de boucherie au pis.
La croissance en parcours des veaux de boucherie au pis laisse voir une certaine périodicité malgré l'uniformité de la conduite des troupeaux. Le rendement des veaux pendant des intervalles de 33 à 50 j entre la naissance et le sevrage, pendant neuf saisons, a laissé constater des intervalles de croissance maximums d'environ 1 kg j^{-1}, mais les taux moyens de croissance saisonnière variaient de 0,79 à 0,99 kg j^{-1}. On pourrait, en maximisant les quantités de fourrage disponibles pendant les 33 derniers jours précédant le sevrage, minimiser les variations saisonnières de croissance des veaux.

Mots clés: Production de veaux, gain de poids vif, parcours

A multitude of biological and management-related factors are known to influence liveweight of suckling calves at weaning. However, periodicity of suckling growth rates in extensively managed range cow-calf commercial operations is poorly quantified. Primary catalysts of this expected periodicity may include the normal transformations in digestive physiology of the preweaned calf and seasonal dynamics of range forages. Ratios of milk to nonmilk nutrient sources utilized by the range beef calf shift in both quantity and quality (Ansotegui 1986). Forage-based nutrients may supply 20% of early age requirements and over 50% of requirements by 90 d of age (Sims et al. 1975). At northern latitudes a decline in nutrient availability associated with maturation of cool-season graminoids, a principle range forage component, typically coincides with the timing of increased nutrient utilization from nonmilk sources by spring-born calves. Examination of intermittent rates of live weight calf gain may identify periods of inconsistent production and infer alternative management opportunities to maximize growth rates.

Our objective was to evaluate sources of variation in growth of suckling range beef calves for successive 33- to 50-d periods from birth to weaning. We hypothesized that under extensively managed production operations in the Northern Rockies maximum

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growth rates would be achieved for the period of 120 to 160 d of age (June-July) for spring-born calves. Subsequent growth rates would both diminish and exhibit greater variability as dietary reliance upon nutrient sparse range forages increased until weaning.

The study area was the Red Bluff Research Ranch, Norris, Montana, that predominantly contained sandy and silty range sites in high-fair to good condition and typical of the foothills of southwest Montana. Dominant vegetation included bluebunch wheatgrass (*Agropyron spicatum*), needle-and thread (*Stipa comata*), Idaho fescue (*Festuca idahoensis*) and basin wildrye (*Elymus canadensis*). Elevation ranged from 1300 to 2000 m with long, slight to moderate slopes and areas of steep slopes. Average annual precipitation ranged from 350 to 406 mm with 40% typically occurring during May and June. Dominant southwesterly winds maintained accessible native forage throughout the winter months and provided for a 10 month yr^{-1} grazing season (May through February) under deferred rotation grazing management. Supplemental forages approximating 100% of daily nutritional requirements were provided for 60 d postcalving.

The cow herd consisted annually of approximately 130 crossbred beef cows. Breed composition was primarily 1/2-Angus × 1/2-Hereford (AH), 3/4-Angus × 1/4-Hereford (3A1H) or 1/2-Tarentaise × 1/4-Angus × 1/4-Hereford (2T1A1H). The cow herd originated in the early 1970's from Montana locations at Northern Agricultural Experiment Station at Havre and the USDA Ft. Keogh Livestock and Range Research Station at Miles City. Calf records were collected on 347 individual cows which comprised the data set. Growth data from 982 crossbred beef calves were recorded over nine seasons from 1976–1982 and 1984–1985. All calves included in analyses were raised on natural dams within the same range environment. Male calves from 1976-1982 and 1985 were surgically castrated within 24 h after the date of second weight. Bull calves in 1984 were adjusted to steer basis (weight × 0.95). Male calves received anabolic growth implants in 1984 and 1985 at the beginning of period 2.

Full weights of March- and April-born calves were obtained at birth (within 24 h), and on or near 13 May, 15 June, 2 Aug., 9 Sept., and 12 Oct. (weaning) with intra-date growth rates assigned as periods 1, 2, 3, 4, and 6, respectively. Mean (±SD) ages (d) for these periods were 0 to 50 (15), 51 to 83 (14), 84 to 130 (15), 131 to 169 (16), and 170 to 202 (14), respectively. Calf weights were not obtained on 2 Aug. 1976 and 1977 and the interval of 15 June-9 Sept. was labeled as period 5 (84–169 d old). Period 7 represented growth rates from birth to weaning (0–202 d old). Calves less than 15 d old by 13 May exhibited extreme variation in initial growth rates (period 1) and were eliminated from the study. Weighing procedures were uniform throughout the study.

Sire breeds and resulting progeny numbers were A, H and T, and 569, 156 and 155, respectively. A sire breed of "other" was assigned to calves (102) without positive sire documentation and these were eliminated from breed interaction analyses. Angus sires were used in all years with H and T sires for a minimum of 5 yr. Breeding seasons began 1 June and natural service was utilized exclusively from 1975 to 1978, During the remaining years an artificial insemination and estrus synchronization program (single prostaglandin injection system) was implemented with inclusion of natural service. All bulls were removed from the breeding pastures by 2 Aug. The average length of the calving season was 63 d with a mean calving date of 24 Mar.

Cows were managed under extensive range conditions as a singular commercial unit without specific regard for age. Culling decisions were implemented in October and based solely on pregnancy status and physical soundness. Selection decisions for replacement heifers utilized the same criteria.

Data were analyzed by least-squares analysis of variance (Statistical Analysis System Institute. Inc. 1985). Dependent variables were individual calf average daily gain during each of the seven periods. Independent variables included year, sex of calf, age of dam (2, 3, 4, 5 to 9, and 10 to 14 yr old), breed of dam (BR), breed of sire (SI), BR × SI interaction and regression of daily gain on date of birth. Inclusion of additional interactions did not approach significance in preliminary analyses and they were excluded from further examinations. Individual mean comparisons were by least significant differences.

Substantial differences in growth rate were observed among periods (Table 1). Mean growth rate was lowest in period 1 (0.78 kg d^{-1}), increased to a maximum in period 3 (1.05 kg d^{-1}) and decreased in period 6 (0.79 kg d^{-1}). Intermediate growth rates were observed for periods 2, 4 and 5. Year was a significant effect for all periods. Period 7 growth rate was lowest in 1979 when period 1 growth rate was also the lowest. Conversely, period 7 growth rate was highest in 1984 and 1985 when period 2 growth rate was also highest.

Sex of calf was an important ($P<0.01$) source of variation in all gain periods. Male calves gained 0.05, 0.03, 0.04, 0.06, 0.06, 0.05 and 0.05 kg d^{-1} more ($P<0.05$) than female calves in periods 1, 2, 3, 4, 5, 6, and 7, respectively. Age of dam significantly affected growth rate for all periods. Calves nursing 2-yr-old dams gained less ($P<0.01$) than all other age groups. Calves of 3-yr-old dams gained significantly less than 4- or 5- to 9-yr-old dams. There were no differences ($P>0.05$) between calves of 4- or 5- to 9-yr-old cows except in period 6 where calves of 5- to 9-yr-old dams were 0.05 kg d^{-1} greater ($P<0.05$) than those of 4-yr-old dams. For period 7, calves of 2-, 3-, 4- and 10 to 14-yr-old dams gained 82, 91, 98, and 96%, respectively, of calves of 5- to 9-yr-old dams (Table 1).

Breed of dam was a significant source of variation in periods 3, 5 and 7. Calf gains (kg d^{-1}) for periods 3, 5, and 7 were 1.07, 1.06 and 1.17, 0.99, 0.99 and 1.10, and 0.85, 0.86 and 0.93 for AH, 3AIH and 2TIAIH, respectively. There were no differences between AH and 3A1H dams at any period. Breed of sire was not significant in any of the seven periods. Sire breed × dam breed interaction influenced calf gains during period 1 ($P<0.01$) and periods 6 and 7 ($P<0.05$).

Calf growth rates differed substantially among periods. However, a consistent curvilinear trend among years was observed. Growth rates increased until period 3, then declined until weaning. Casebolt et al. (1983) reported that milk production for beef cows grazing Montana rangeland was at its lowest by 130–145 d of lactation. Concurrently, dry matter intake has been reported to increase with advancing age. Roy (1958) concluded that calves can be entirely dependent upon good quality grass and gain 0.59 kg d^{-1} by 56 d of age. Ansotegui (1986) analyzed intake and growth data on cows and calves at the Red Bluff Research Ranch. Estimates of organic matter intake indicated that calves may have become self-sufficient at 70–100 d of age when adequate forage was available. Calves consumed 0.6 kg more forage for each kg reduction in milk intake, became forage grazers at a very early age (45 d old), and possessed many similarities to mature ruminants with regard to forage intake and digesta kinetics. However, dietary quality differences between calf and dam indicated calves were inexperienced and exploratory grazers. For our data, the greater variability associated with period 6 growth rates may indicate an increased reliance by the calf upon a tenuous forage supply. Seasonal, or year, effects were substantial for all periods. Fredeen et al. (1982) reported that calf growth traits were significantly influenced by year effects due, primarily, to calf age differences at weaning. The consistency in calf age at weaning in our study would suggest a requirement for alternative explanations. Year effects were more pronounced during periods 1, 2 and 6. Though within period gains of >1.0 kg d^{-1} were achieved for each period during at least one year of the study, the occurrences were minimal for periods 1, 2 and 6.

Ratios of the minimum and maximum growth rate within each period across all seasons were calculated as a simple index to period variability among years. These ratios were 0.56, 0.55, 0.80, 0.75, 0.80 and 0.45

Table 1. Least-squares means and standard errors of calf growth rates (kg d^{-1}) for seven discrete preweaning periods classified by year, sex and age of dam (AOD)

	Period†						
Factor	1	2	3	4	5	6	7
Year							
1976	0.60±0.02*a*	0.84±0.02*bc*			0.92±0.01*b*	0.98±0.02*d*	0.84±0.01*b*
1977	0.70±0.03*b*	0.80±0.02*b*			0.96±0.02*c*	0.96±0.03*d*	0.88±0.01*bc*
1978	0.77±0.02*c*	0.86±0.02*c*	0.90±0.02*a*	0.91±0.02*b*	0.90±0.01*b*	0.79±0.03*c*	0.84±0.01*b*
1979	0.57±0.02*a*	0.92±0.02*d*	0.93±0.02*a*	0.80±0.02*a*	0.85±0.02*a*	0.77±0.03*c*	0.79±0.01*a*
1980	0.61±0.02*a*	0.92±0.02*d*	1.02±0.02*b*	0.88±0.02*a*	0.97±0.01*c*	0.67±0.02*b*	0.85±0.01*b*
1981	1.02±0.02*e*	0.67±0.02*a*	1.13±0.01*c*	0.99±0.02*b*	1.06±0.01*d*	0.53±0.02*a*	0.89±0.01*c*
1982	0.71±0.01*b*	0.93±0.02*d*	1.12±0.01*c*	0.86±0.02*a*	0.98±0.01*c*	0.50±0.02*a*	0.86±0.01*bc*
1984	0.73±0.02*bc*	1.17±0.02*e*	1.06±0.02*c*	1.02±0.02*c*	1.04±0.01*d*	1.10±0.02*e*	0.99±0.01*e*
1985	0.90±0.02*d*	1.21±0.02*e*	1.08±0.02*c*	1.06±0.02*c*	1.06±0.01*d*	0.70±0.02*b*	0.93±0.02*d*
Sex							
Female	0.71±0.01*a*	0.91±0.01*a*	1.01±0.01*a*	0.90±0.01*a*	0.94±0.01*a*	0.75±0.01*a*	0.85±0.01*a*
Male	0.76±0.01*b*	0.94±0.01*b*	1.05±0.01*b*	0.96±0.01*b*	1.00±0.01*b*	0.80±0.01*b*	0.90±0.01*b*
AOD (yr)							
2	0.52±0.02*a*	0.81±0.02*a*	0.92±0.02*a*	0.82±0.02*a*	0.87±0.02*a*	0.71±0.03*a*	0.75±0.01*a*
3	0.71±0.02*b*	0.89±0.02*a*	1.00±0.02*b*	0.90±0.02*b*	0.94±0.01*b*	0.78±0.02*b*	0.85±0.01*b*
4	0.83±0.02*c*	0.97±0.02*b*	1.10±0.02*c*	1.00±0.02*c*	1.03±0.01*c*	0.78±0.02*b*	0.93±0.01*c*
5- 9	0.81±0.02*c*	0.98±0.02*b*	1.07±0.01*c*	0.98±0.01*c*	1.02±0.01*c*	0.83±0.01*b*	0.93±0.01*c*
10–14	0.80±0.03*c*	0.96±0.02*b*	1.07±0.02*c*	0.96±0.02*c*	1.01±0.01*c*	0.79±0.02*b*	0.91±0.01*c*
$\overline{X}$	0.78 0.16	0.96 0.17	1.05 0.16	0.95 0.18	1.00 0.13	0.79 0.22	0.91 0.01

†1 = 0–50 d old, 2 = 51–83 d old, 3 = 84–130 d old, 4 = 131–169 d old, 5 = 84–169 d old, 6 = 170–202 d old, 7 = 0–202 d old.
*a–e*Means within a column and factor with different letters differ ($P<0.05$).

for periods 1, 2, 3, 4, 5 and 6, respectively. Unequal effects of husbandry (branding, surgical castration) and environmental (variable and harsh spring storms) factors more characteristic of periods 1 and 2 could contribute to their lower ratios. Though milk production estimates were not obtained, dam breeds which may have influenced differences in milk production (and resulting calf gains during early lactation) were not consistent among years. These inconsistencies may have contributed to an expression of greater intraperiod variability.

The increasing importance of a forage source for satisfying nutritional demands of the older suckling calf could explain the reduced ratio for period 6. Yearly variations in both quantity and quality of available forage during September and October are typically substantial for cool season graminoids. Baker et al. (1981a) reported calves were unable to compete with their dams to maintain both forage intake and daily live weight gain as available forage was restricted. A similar effect was demonstrated by Baker et el. (1981b) when increasing stocking rates depressed calf gains by 0.03 to 0.09 kg d^{-1}. Incorporation of management strategies, such as grazing systems, which mitigate declines in either forage quality or quantity could assist the maintenance of growth rates near period 4 levels.

In general, these data support the concept of a maximum potential growth rate of slighly over 1 kg d^{-1} for suckling calves under these extensive rangeland conditions. The yearly consistency of growth rates during periods 3 and 4 minimized effects of periods 1, 2 and 6 variation and maintained similarity in overall (period 7) growth rates. However, the difference between an overall growth rate of 0.79 and 0.99 kg d^{-1} is approximately 41 kg in calf weight at weaning. Various animal and range management options which maximize growth rates during periods 1, 2 and 6 could be evaluated for economic returns based on their potential for increase in calf production.

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