AgriLIFE EXTENSION
Texas A&M System

B-6124
8-02

RangeDetect Series

Forage Quality and Quantity in Texas — Managing Nutrition in Range Beef Cattle

Robert K. Lyons, Richard V. Machen and Jerry W. Stuth*

Cattle nutritional management is a major challenge for range beef producers. Objectives of this management are to maintain animal productivity, minimize feed costs and preserve the forage resource. To accomplish these objectives, producers must match forage quality and supply with animal needs while still leaving enough forage residue to ensure healthy plants and rangelands. Nutritional management is complicated by changing forage quality and quantity.

This publication discusses:

- Forage quality trends in various regions of Texas.
- Tools to analyze the nutritional environment of cattle and differentiate between forage quality and availability problems.
- Nutritional management strategies.

Forage Quality

Forage quality is typically expressed in terms of protein content and digestibility or energy content. Several factors influence forage quality—plant species, plant part, stage of maturity and growing conditions. The value of a specific forage quality for a grazing animal depends on animal species, size and physiological state. For example, 7 percent crude protein may be good enough for a dry cow but not sufficient for a cow at peak lactation.

Forage Quantity

Although forage quality is important, the amount of forage available to a grazing animal is equally important. If forage is high in quality but scarce, animals may have trouble consuming enough forage to meet nutritional requirements and may use excess energy searching for it.

Grazing animals, including cattle, are selective in what they choose to eat. Studies have reported instances where as much as 80 percent of the diet came from 1 percent of the forage standing crop. Therefore, forage available to a grazing animal is that part of the forage that an animal chooses to eat. When less forage is available, animals may become less selective in the plants they choose, which can cause problems if toxic plants that are usually not eaten are present.

Estimating Forage Diet Quality

It is relatively easy to obtain an estimate of nutritional value of hay by taking and sending a core sample to a lab for analysis. Estimating the diet quality of the forage consumed by a grazing animal is more complicated because grazing animals, especially under rangeland conditions, select among a number of plant species and try to select specific plant parts, primarily green leaves.

In the late 1940s, scientists investigated the possibility of using fecal analysis to estimate forage diet quality of grazing cattle and sheep. This approach was based on the concept that forage residue in feces represents what the grazing animals ate.

In the late 1980s, Texas scientists began using near infrared reflectance spectroscopy (NIRS), a rapid analysis technique, to analyze feces to estimate forage diet crude protein and digestibility. Forage diet quality estimates presented in this publication were obtained using NIRS analysis of cattle feces. Regional forage estimates were obtained from samples submitted to the Grazingland Animal Nutrition Lab at Texas A&M University over a 10-year period.

*Associate Professor and Extension Range Specialist; Associate Professor and Extension Livestock Specialist; and Professor–Department of Rangeland Ecology and Management, The Texas A&M University System

Regional Cattle Forage Diet Quality Trends

Regional monthly average crude protein and digestibility estimates are shown in Figures 1-10. Highest overall diet quality occurred in the East Texas Pineywoods (Figure 1), Post Oak Savannah (Figure 2), Blackland Prairie (Figure 3) and Cross Timbers (Figure 4) regions. In general, forage quality tended to peak for both crude protein and digestibility around April (Figures 1-10). For the Post Oak Savannah (Figure 2), this peak was from March to April, compared to April and May for the Blackland Prairie (Figure 3). In the High Plains (Figure 9), an initial peak occurred from April through June with an additional peak in August. Peaks in the Trans Pecos occurred in April and again in July-August (Figure 10).

Crude protein and digestibility estimates vary among regions throughout the year (Table 1). Following the spring peaks, crude protein declined fairly rapidly and steadily in regions with the highest peak estimates (Figures 1-4). In most regions, digestibility did not decline as rapidly as crude protein. One exception to this tendency was in the Post Oak Savannah (Figure 2).

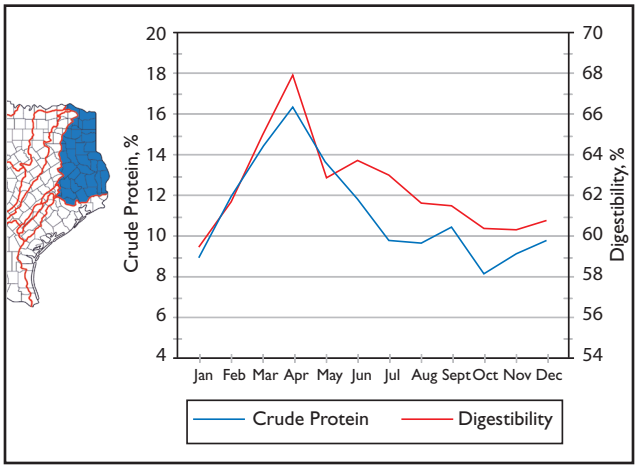

Figure 1. East Texas Pineywoods

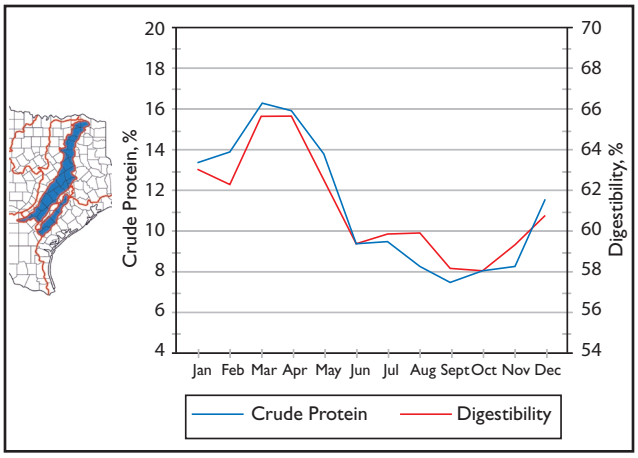

Figure 2. Post Oak Savannah

Average monthly high crude protein levels among regions ranged from 10 to 16 percent. In comparison, average monthly low crude protein levels were fairly similar among regions, with a range of 7 to 9 percent and mostly 7 to 8 percent, except for the South Texas Plains. All regions had maximum crude protein estimates of 19 to 30 percent, while minimum estimates ranged only from 2 to 4 percent. (See Table 1.)

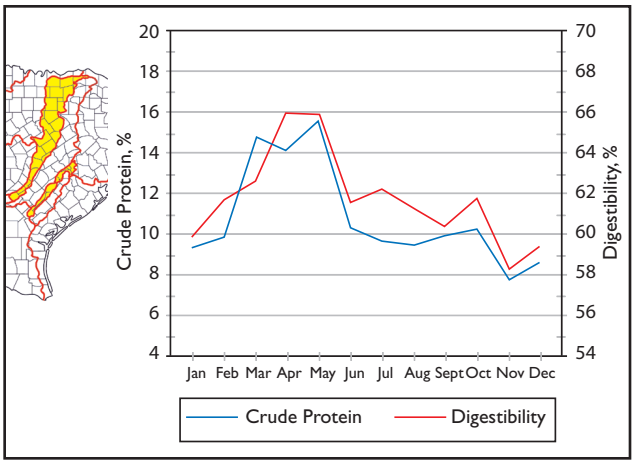

Figure 3. Blackland Prairie

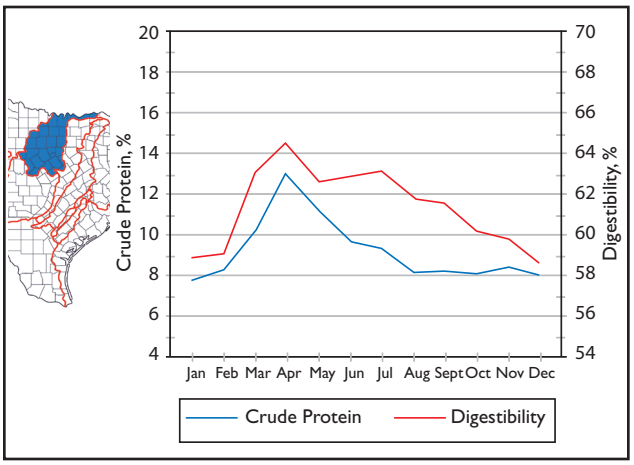

Figure 4. Cross Timbers

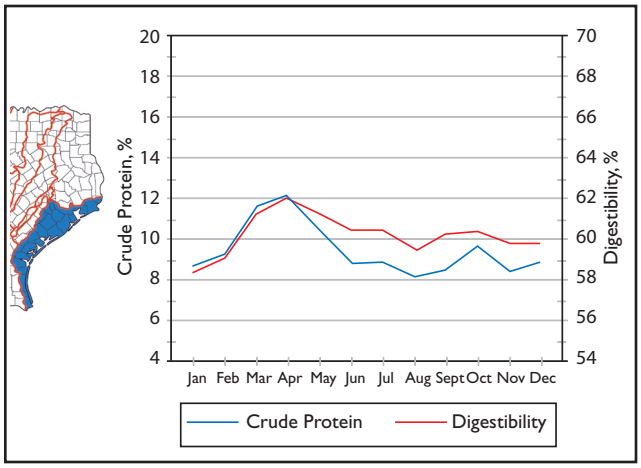

Figure 5. Gulf Coast Prairie

Average high monthly digestibility estimates ranged from 62 to 68 percent among regions. Average low monthly estimates ranged from 58 to 60. Maximum estimates ranged from 71 to 80 percent, and minimum estimates from 44 to 54. (See Table 1.)

Monthly crude protein and digestibility estimates varied by region depending on regional conditions and individual ranch situations. Average monthly crude protein

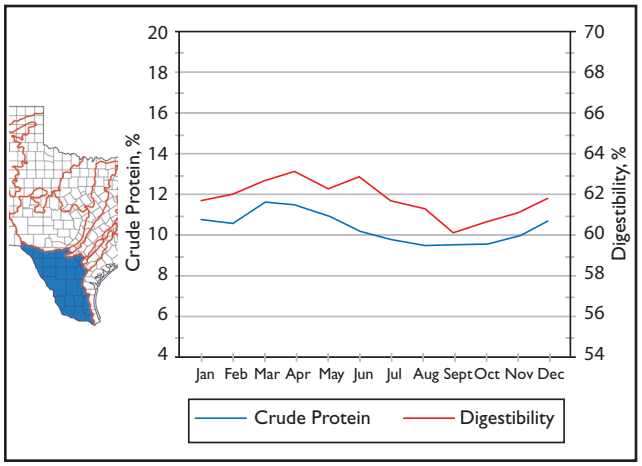

Figure 6. South Texas Plains

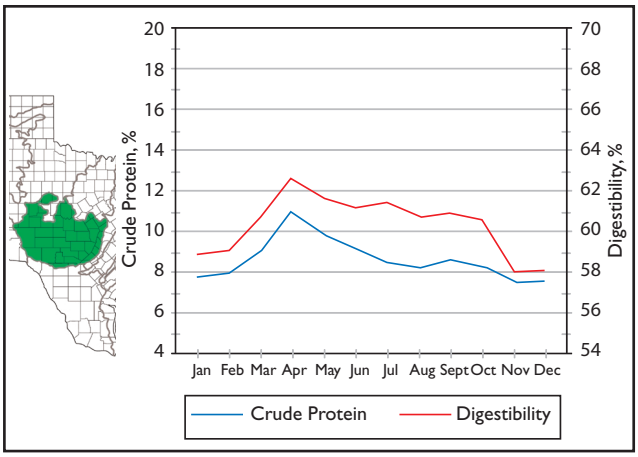

Figure 7. Edwards Plateau

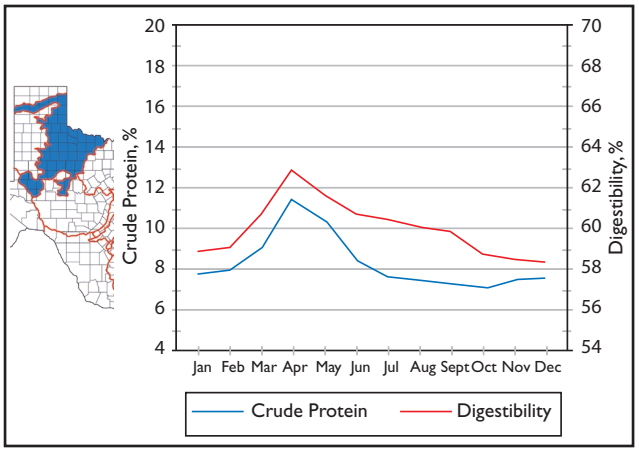

Figure 8. Rolling Plains

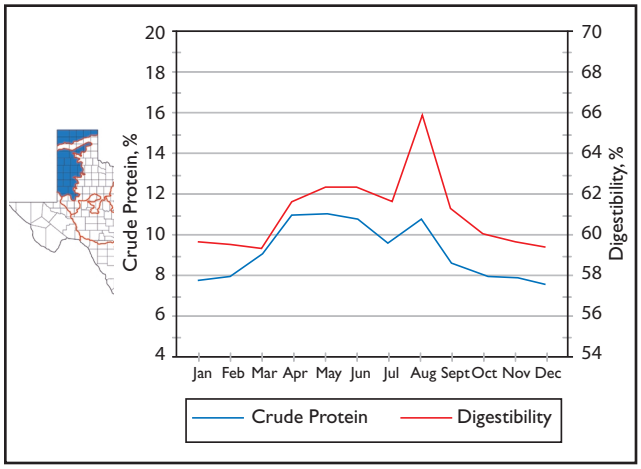

Figure 9. High Plains

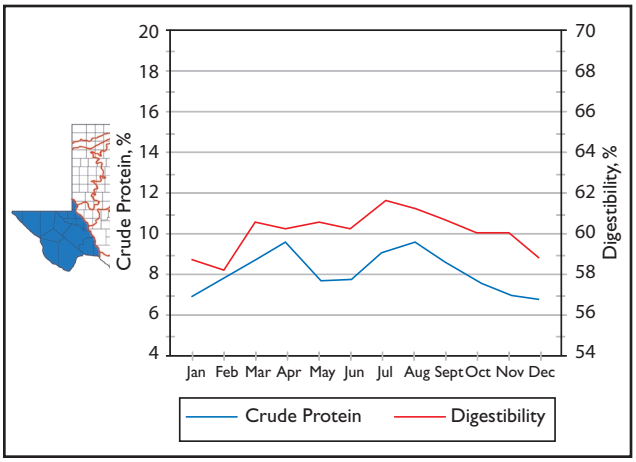

Figure 10. Trans Pecos

estimates (Figure 11) differed among regions by 7 to 8 percent from March through May. In other months, these differences were 3 to 5 percent. Average monthly digestibility (Figure 12) differed among regions by 8 to 9 percentage points from April through June and by 3 to 6 percent in other months.

Estimating Forage Availability

Estimating the pounds of grass in a pasture is relatively simple and can be done by clipping samples, which is simple but not necessarily enjoyable, or by visually estimating grass quantities. Although these estimates are useful for management practices such as prescribed burning and watershed management, such estimates may not be as valuable in determining forage available to grazing animals. If estimates of pounds of grass are not made for the grass species animals are eating or going to eat, they can be misleading in terms of nutritional management.

Extension demonstrations have used a nutritional analysis system to estimate forage intake, an indicator of forage availability. This system includes 1) NIRS fecal analysis to estimate forage diet quality, 2) the Nutritional Balance Analyzer (NUTBAL PRO) computer software to estimate animal performance, and 3) visual cow body

Table 1. Average high and low, maximum and minimum crude protein and digestibility estimates within regions.

Region	Crude protein, %				Digestibility, %			
	Average		Maximum	Minimum	Average		Maximum	Minimum
	High	Low			High	Low		
East Texas Pineywoods	16	8	23	3	68	60	76	54
Post Oak Savannah	16	7	28	3	65	58	76	49
Blackland Prairie	16	8	24	4	66	58	71	53
Cross Timbers	13	8	20	4	65	59	75	52
Gulf Coast Prairie	12	8	19	3	62	58	74	52
South Texas Plains	12	9	30	4	63	60	80	53
Edwards Plateau	11	7	22	3	63	58	76	44
Rolling Plains	12	7	30	4	63	60	80	53
High Plains	11	7	21	4	66	59	82	53
Trans Pecos	10	7	28	2	62	58	74	50

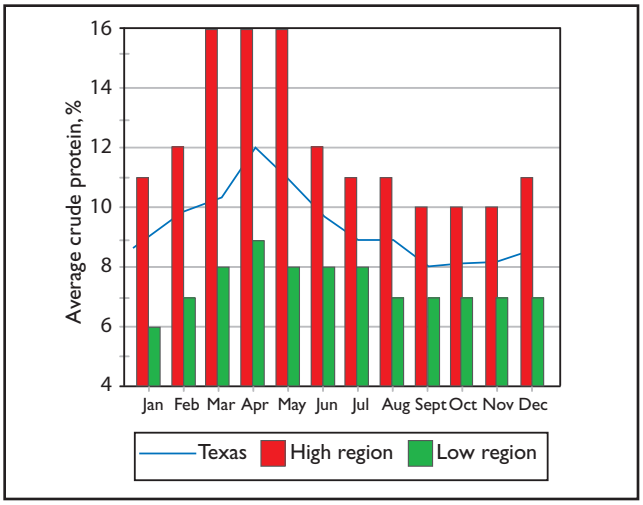

Figure 11. Monthly estimates of average range beef cattle diet crude protein for Texas and high and low regions of the state

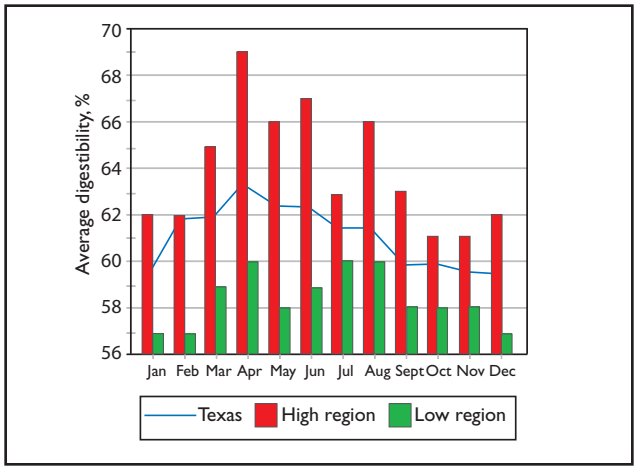

Figure 12. Monthly estimtes of average range beef cattle diet digestibility for Texas and high and low regions of the state

condition scoring to estimate forage intake. In these demonstrations, apparent forage intake was estimated by adjusting NutBal forage intake to match animal performance. Using this system provided a means of distinguishing between forage quality and forage availability as a source of nutritional problems.

Figure 13 illustrates the use of this system to estimate apparent forage intake on a South Texas Plains ranch. Apparent forage intake increased until May, then declined with dry conditions and fluctuated with rainfall. This pattern suggests that the cows were selective in what they grazed and that the availability of preferred forages fluctuated.

Results from a demonstration conducted in the eastern Edwards Plateau show the importance of forage availability. This demonstration was conducted for a 3-year period during which fecal samples and body condition scores were taken monthly in both spring-calving and fall-calving herds. These herds were on the same ranch with the same range sites and terrain but in different pastures.

Spring- and fall-calving herd forage quality trends were similar to each other and to general Edwards Plateau trends (Figure 7). However, body condition scores were lower for the spring-calving herd (about 5) than for the fall-calving herd (5.5) from weaning through breeding.

Although a condition score of 5 is generally considered acceptable, why would fall herd condition scores be higher, since these two herds were on the same ranch and range sites? The answer appears to be forage intake (Figure 15 and Table 2). Comparing these two herds from the second month after weaning (December/July) through the second month of the calving season (March/October), the spring-calving herd had an apparent forage intake deficit of 6 to 11 pounds per day (average 8.25 pounds) compared to a 1- to 5- pound per day deficit for the fall herd (average 2.5 pounds).

Table 2. Comparison of forage quality, stock density, body condition score changes and apparent forage intake deficits for spring-calving (SC) and fall-calving (FC) herds on the same Eastern Edwards Plateau ranch grazing the same range sites in different pastures.

	Crude protein, %		Digestibility, %		Stock density, ac/cow		Body condition score change		Apparent forage deficit, lbs/day	
Physiological state	**SC**	**FC**	**SC**	**FC**	**SC**	**FC**	**SC**	**FC**	**SC**	**FC**
Weaning (Oct/May)	8.0	9.5	59	61	9	36	0	0.4	-11	-5
Dry & bred (Nov/Jun)	6.4	7.8	58	60	10	34	0.4	-0.1	0	-6
Dry & bred (Dec/Jul)	6.5	7.7	58	60	10	21	-0.2	0.1	-11	-5
Dry & bred (Jan/Aug)	6.8	8.1	57	60	11	32	-0.1	0.2	-7	-2
Calving (Feb/Sep)	8.1	7.9	60	60	18	37	-0.1	-0.1	-6	-2
Calving (Mar/Oct)	9.1	7.3	60	59	14	35	-0.3	-0.1	-9	-1
Calving & breeding (Apr/Nov)	12.2	6.8	63	58	19	31	0.4	-0.2	0	-2
Breeding (May/Dec)	9.0	7.6	61	58	11	31	-0.3	-0.2	-5	-6
Breeding (Jun/Jan)	7.4	7.1	59	58	11	34	-0.1	-0.4	-2	-12

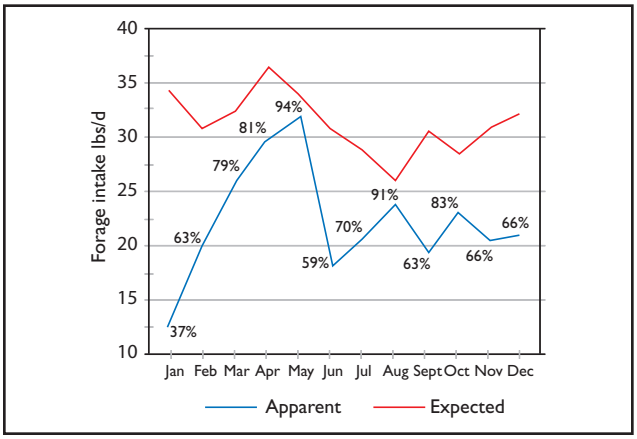

Figure 13. Example of seasonal fluctuatins in apparent forage intake on a South Texas Plains ranch over a 2-year period. Apparent forage intake approaches expected forage intake as the growing season progresses to May and then fluctuates with rainfall. (Percentages above the line indicate the portion of expected intake reached by apparent forage intake.)

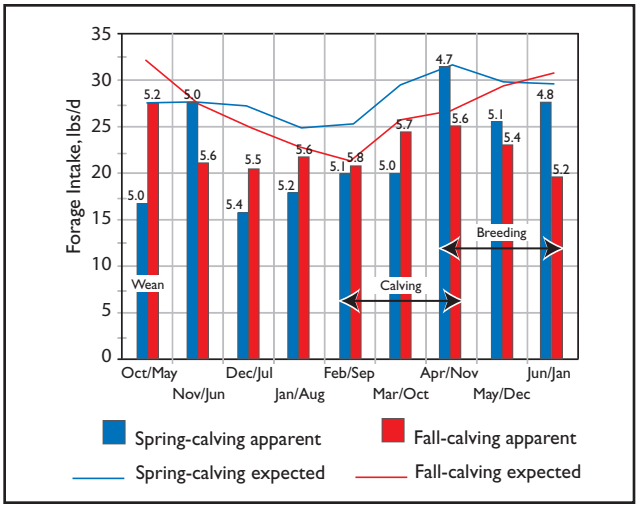

Figure 14. Expected verus apparent forage intake for spring-calving and fall-calving herds at the same physiological state on the same eastern Edwards Plateau ranch over a 3-year period. (Numbers above bars indicate cow body condition score.)

Since average estimated forage quality for the two herds was similar for this period (Table 2), why would apparent forage intake be so different? In this case, the answer appears to be stock density (acres per cow at a given time). From weaning through breeding, the spring herd had a stock density of 1.6 to 4 times greater (average of about 20 acres less per cow for the spring herd) than the fall herd. For the period from December/July through March/October, the spring herd was stocked at a density 2.3 times greater (average of 18 acres less per cow) than the fall herd. Therefore, higher stock density resulted in less available forage and less forage intake for the spring-calving herd.

Body condition score in the fall-calving herd decreased from 5.6 to 5.2 during breeding. Apparent forage intake declined steadily during this period. (See Figure 14.) This breeding season occurred from November through January, a period of little or no forage growth. Therefore, fall-calving cows need to be at better than body condition score 5 at calving to withstand these kinds of losses and remain in acceptable body condition during breeding.

Strategic Supplemental Feeding

Supplemental feeding should enhance forage intake and/or correct deficiencies in forage quality. Both time of day and frequency of feeding can affect forage use efficiency. Timing feeding according to cow physiological state is important to achieve an efficient supplemental feed response.

Supplemental feed should not be offered during major grazing periods. An example from Extension result demonstration work using the nutritional analysis system described above illustrates this point (Figure 15). During this analysis period, the rancher was asked to manage supplemental feedings in the normal manner for the ranch. In year 1, supplemental feed was offered to cows at about 8 to 9 am. In year 2, no supplemental feed was offered. Forage quality was the same for the two years. Apparent forage intake in year 2, when no supplement was offered, is higher than in year 1, suggesting that feeding during the morning major grazing period in year 1 interrupted grazing and reduced forage intake.

Research has shown that feeding frequency affects grazing behavior. Cows fed daily stay closer to and longer at feeding areas. Cows fed once a week graze more of the pasture. Once-a-week feeding can be done only with a high protein feed (greater than 30 percent). However, high energy feeds, especially high starch feeds, may cause digestive upsets if fed only once a week.

To illustrate timing of supplemental feeding for optimum efficiency relative to cow production stage, spring- and fall-calving schedules were analyzed with the NutBal program. Using estimated forage diet quality and apparent forage intake from the eastern Edwards Plateau herds described above and a central Edwards Plateau herd, this analysis indicated that the only period where supplemental feed could be used efficiently (in small quantities) to improve cow body condition was during the period from weaning to calving. This conclusion agrees with standard recommendations. Cows have a lower physiological demand during this period and can, therefore, convert excess nutrient intake to body reserves.

Tables 3 and 4 provide estimates of supplemental feeding requirements (assuming a 41 percent crude protein, 75 percent TDN supplemental feed analysis) for these calving schedules for a 0.5 body condition score gain or maintenance during four 30-day periods from 120 days pre-calving to calving. Supplemental feed estimates differ depending on forage quality and/or availability on individual ranches and for individual herds. For example, for the eastern Edwards Plateau spring- calving schedule, there is only one 30-day period where supplemental feed could efficiently improve body condition by one-half score. For the central Edwards Plateau spring-calving herd schedule, there are two periods where efficient gain appears possible. The large amounts of supplemental feed needed closer to calving illustrate that waiting until the last minute to attempt to increase body condition score is neither economical nor feasible. Therefore, the feeding strategy would be to improve condition score where it is efficient to do so and feed for maintenance or slower gains during other periods. In many instances in these examples, maintenance required no feed. Therefore, it is crucial that body condition scoring be used as a guide to any feeding program.

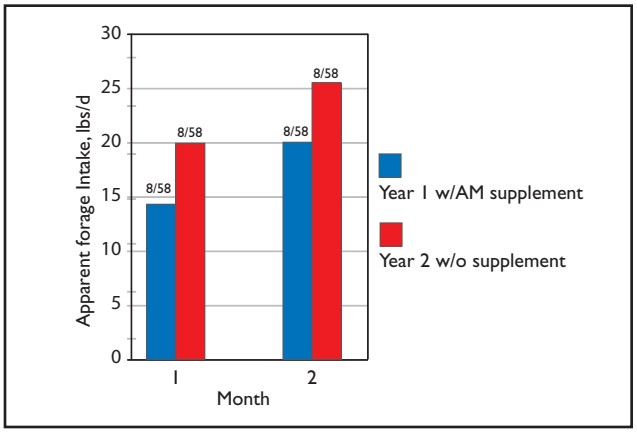

Figure 15. Supplemental feeding during a major grazing period reduces forage intake by interrupting grazing. (Numbers above bars indicate estimated crude protein and digestibility.)

Management Recommendations

- Average regional trends serve as a good indication of changes in the diet quality of grazing beef cattle. However, ranches and even pastures within ranches may vary from these averages as evident from the large range of reported values within any single month. More individualized information can be obtained from fecal analysis.
- Stocking rates and stock densities can have a marked influence on forage availability and, therefore, forage intake. Forage availability is equally as important as forage quality in nutritional management. Using the nutritional analysis system of NIRS fecal analysis, NutBal computer software and body condition scoring can help distinguish between forage quality and forage availability problems.
- Because the fall-calving breeding season occurs during a period when forage quality is declining and/or less available, these cows need to be in better than a 5 condition score at calving to withstand probable condition score losses following calving and remain in acceptable body condition during breeding.
- Do not offer supplemental feed during major grazing periods during the day. Offer supplemental feed during midday to avoid interfering with grazing.
- Consider feeding supplemental feed once a week to improve pasture grazing distribution and use. With once-a-week feeding, provide a high protein (>30 percent) supplement.
- Concentrate efforts to improve body condition on the period between weaning and calving. Use historic body condition scores as a guide to what can be expected. Use current body condition scores to decide how to manage supplemental feeding.

Table 3. Examples of spring-calving (March) supplemental feeding strategies from Extension result demonstrations assuming a 41 percent crude protein, 75 percent TDN supplemental feed analysis.

		30-day performance goal and estimated supplemental feed requirement		
Location	**Days pre-calving**	**0.5 BSC gain**	**Maintenance**	**Suggested feeding strategy**
Eastern Edwards Plateau Ranch	120	1	0	feed for gain if needed
	90	6.7	0	maintenance or slower gain
	60	7.8	1.7	maintenance or slower gain
	30	6.6	1.2	maintenance or slower gain
Central Edwards Plateau Ranch	120	2	0	feed for gain if needed
	90	1.3	0	feed for gain if needed
	60	5.5	0	maintenance or slower gain
	30	8	1.7	maintenance or slower gain

Table 4. Examples of fall-calving (September) supplemental feeding strategies from Extension result demonstrations assuming a 41 percent crude protein, 75 percent TDN supplemental feed analysis.

		30-day performance goal and estimated supplemental feed requirement		
Location	**Days pre-calving**	**0.5 BSC gain**	**Maintenance**	**Suggested feeding strategy**
Eastern Edwards Plateau Ranch	120	4.5	1.4	maintenance
	90	1.4	0	feed for gain if needed
	60	3.5	0	feed for gain if needed
	30	3	0	feed for gain if needed
Central Edwards Plateau Ranch	120	5.5	0	maintenance
	90	2.2	0	feed for gain if needed
	60	8.7	0	maintenance or slower gain
	30	12.4	1.2	maintenance or slower gain

For more information

L-5359, “Forage Quality Photo Guide: Evaluating Diet Quality Selected by Grazing Beef Cattle Using Photographic Guidelines.” Texas Cooperative Extension.

L-5385, “Interpreting Grazing Behavior.” Texas Cooperative Extension.

L-5400, “Stocking Rate: The Key Grazing Management Decision.” Texas Cooperative Extension.

E-102, “Using Body Condition Scores to Manage Range Cows and Rangeland.” Texas Cooperative Extension.

L-5409, “Livestock Grazing Distribution: Considerations and Management.” Texas Cooperative Extension.

B-6067, “Supplementation Strategies for Beef Cattle.” Texas Cooperative Extension.

B-1526, “Body Condition, Nutrition and Reproduction of Beef Cows.” Texas Cooperative Extension.

Grazingland Animal Nutrition Lab: *http://cnrit.tamu.edu/ganlab/*

Support for this publication was provided by Texas Cooperative Extension Risk Management initiative.

Produced by AgriLife Communications and Marketing, Texas A&M System
Extension publications can be found on the Web at: http://AgriLifebookstore.org

Visit the Texas AgriLife Extension Service at http://texasextension.tamu.edu

Educational programs of the Texas AgriLife Extension Service are open to all people without regard to race, color, sex, disability, religion, age, or national origin.

Issued in furtherance of Cooperative Extension Work in Agriculture and Home Economics, Acts of Congress of May 8, 1914, as amended, and June 30, 1914, in cooperation with the United States Department of Agriculture. Edward G. Smith, Director, Texas AgriLife Extension Service, Texas A&M System.