Cattle, Browse, and Range Health

Cattle in South Texas eat some browse, but what are the nutritional and ecological consequences when heavy browse use occurs?

By Robert K. Lyons and Jerry W. Stuth

Heavy browse use by cattle in South Texas is not good for either the cattle or range health.

Woody plants make up a large portion of the vegetation in South Texas. As a result, these plants provide large amounts of potential browse (woody plant leaves and young stems) for white-tailed deer. Some have suggested that this browse is a valuable forage resource for cattle. However, it is doubtful that cattle are suited to eating many South Texas browse species that often have small leaves and large thorns.

Cattle are classified as grazers[1] with a mouth built to eat grasses. Cattle have an inflexible upper lip and use their tongues to grasp and pull forage into their mouths, giving their heads a jerk to break off forage.

Annual cattle diets in Texas typically contain less than 7%–10% browse. A seasonal cattle diet study on a South Texas ranch found that browse made up mostly 2%–3% of the diet and was highest (12%) in winter.[2]

The study discussed here was conducted to determine 1) the ability of South Texas browse to meet nutritional requirements of growing beef steers and mature dry and lactating beef cows and 2) grass standing crop levels at which cattle shift to browse.

Collection of Supporting Data

Data used as a basis for the nutritional analyses presented here were collected during a diet study conducted about 40 miles west of Corpus Christi, Texas. Detailed experimental procedures have been reported by Stuth and Lyons.[3] Brush (trees and shrubs) in the study area was either chained or chained and sprayed with herbicide to create variations in available grass and browse. Study areas were grazed with steers during 4 21-day grazing trials. During each trial, grass standing crop was grazed to a 90% utilization level. Diet, fecal, and vegetation samples were collected 4–5 times per trial to estimate changes in 1) forage quality, 2) forage intake, and 3) plant groups in the diet.

Cattle in South Texas can be seen eating browse mostly when grass is scarce. Photo courtesy of Wayne Hanselka.

Percent grass, forbs, and browse were determined from diet samples collected with esophageal fistulated steers. Diet crude protein (CP) and digestibility were estimated using standard procedures.[3] Digestibility was calculated as digestible organic matter (DOM) and corrected to in vivo

using standards. Fecal output was estimated and used with diet indigestibility to calculate forage intake.

Analysis of Nutritional Potential

For nutritional analyses, diet indigestibility and fecal output estimates were used to calculate dry matter intake [Forage dry matter intake = (Live weight (% Fecal output/100))/(1 − (% Digestibility)/100)] for 640-pound steers and 1,140-pound dry and lactating cows. Using dry matter intake and CP and DOM values, CP and energy intake were calculated for each sampling period of each trial. From these nutrient intake values, potential CP and energy gain were determined for steers and CP and energy maintenance were determined for cows based on National Research Council Nutrient Requirements of Beef Cattle.[4]

Forage Quality and Intake Declined

Pasture treatments (chained and chained + herbicide-sprayed) created differences in initial grass standing crops. Average initial grass standing crop was higher ($P < 0.05$) in chained + herbicide-sprayed pastures ($\bar{X} = 2{,}052$ lb·acre^{-1}) than in chained pastures ($\bar{X} = 1{,}018$ lb·acre^{-1}). Likewise, average initial browse level was higher ($P < 0.05$) in chained pastures ($\bar{X} = 1{,}780$ lb·acre^{-1}) than in chained + herbicide-sprayed pastures ($\bar{X} = 1{,}004$ lb·acre^{-1}).

Beginning diet browse levels ranged from 1%–5% across trials. Ending browse levels were above 50% in chained pastures and around 20% in chained + herbicide-sprayed pastures.

As browse increased in the diet, both grass standing crop and fecal output decreased (Table 1). These results suggest 2 things. First, steers shifted to browse as grass became less available. Second, forage intake could not be maintained as browse consumption increased.

In the March trial, CP declined fairly steadily across sampling periods. In contrast, after initial declines, CP in May, August, and January tended to level off or increase toward the end of the trial. Average CP declined initially and then increased slightly toward the end of trials (Fig. 1).

Digestibility in March declined markedly after the first sampling period and then leveled off. In May, August, and January, digestibility declined steadily across sampling periods. Average digestibility declined steadily during trials (Fig. 1). This decline corresponded ($r = -0.64$) to increasing browse in the diet.

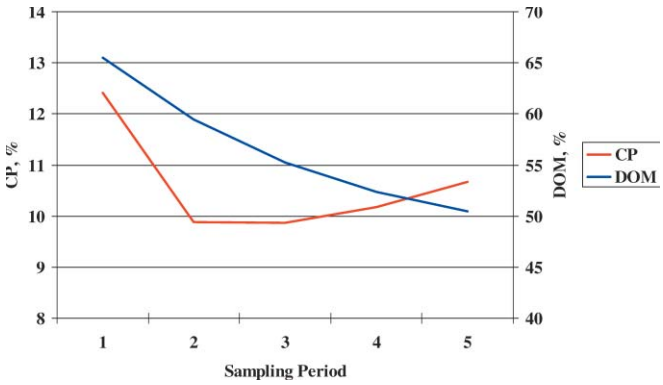

Figure 1. Average diet crude protein (CP) and in vivo corrected digestible organic matter (DOM) trends across sampling periods during 4 21-day field trials illustrate the effect of increasing dietary browse. After an initial decline, CP tended to increase slightly toward the end of trials. In contrast, there was a steady decline in digestibility.

Browse Decreased Potential Steer Gain

Figure 2 illustrates potential gain for growing steers based on calculated crude protein intake and nutrient requirements.[4] In all trials, potential gain decreased as dietary browse increased. In March, August, and January, potential gain fell below 2 lb·d^{-1} between 1% and 25% dietary browse and below 1 lb·d^{-1} between 2% and 25% dietary browse and then approached zero. In May, potential CP gain fell below 2 lb·d^{-1} above 25% dietary browse and remained above 1 lb·d^{-1} across the entire trial.

Potential energy gain also decreased as dietary browse increased (Fig. 2). Energy tended to be the first limiting requirement for gain. August was the only trial where CP was the first limiting requirement for gain. In March, August, and January, potential gain fell below 2 lb·d^{-1} above 1% dietary browse and below 1 lb·d^{-1} above 5% and 8% dietary browse and then approached zero. In May, potential gain fell below 2 lb·d^{-1} above 10% dietary browse and below 1 lb·d^{-1} above 30% dietary browse.

Browse Decreased Potential Cow Maintenance

For mature, dry cows, crude protein intake (Fig. 3) remained at or above maintenance requirements across the range of dietary browse. However, for mature lactating cows, crude protein intake fell below requirements between 2% and 15% dietary browse, depending on the trial.

Table 1. Correlations (*r*) for grass standing crop (GSC), fecal output as a percent of body weight (FO), and percent dietary browse (DB) for each trial

	March	May	August	January
GSC vs FO	0.91	0.81	0.79	0.84
GSC vs DB	–0.71	–0.76	–0.50	–0.51
FO vs DB	–0.70	–0.92	–0.75	–0.43

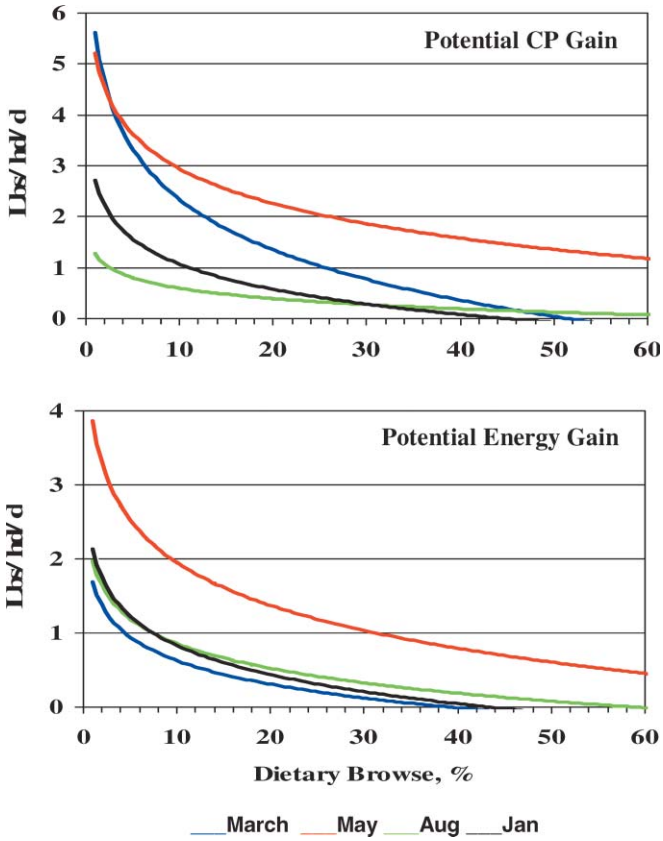

Figure 2. Potential gain for steers based on crude protein (CP) and energy intake for each of the 4 field trials. Curved lines represent the general relationship between percent dietary browse and potential gain. Energy was the first limiting requirement in every trial except August.

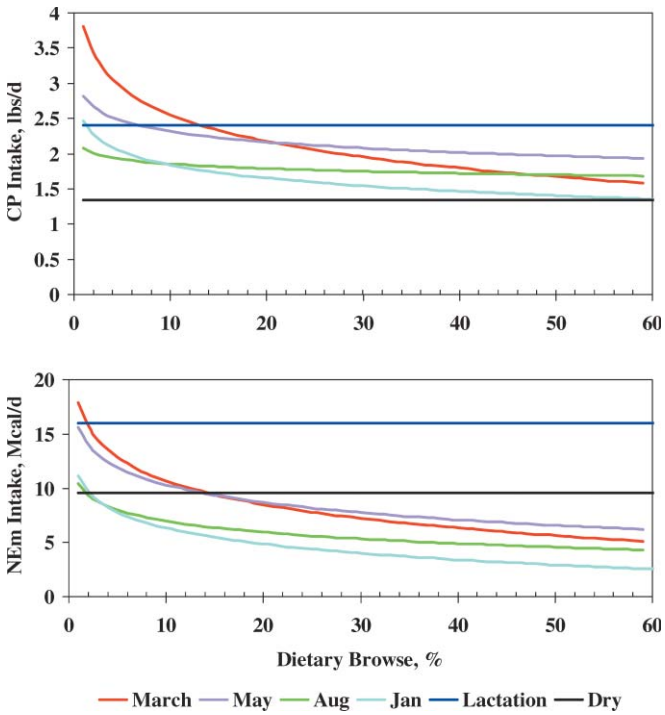

Figure 3. Curved lines represent the relationship between dietary browse and potential crude protein (CP) and net energy of maintenance (NEm) intake during each of the 4 trials. Horizontal lines represent crude protein and NEm intake requirements for 1,140-pound lactating (75 days) and dry cows. Intersections of curved and horizontal lines indicate crude protein and energy thresholds for maintenance.

As with steers, energy was the first limiting requirement for mature-cow maintenance. For dry cows, net energy of maintenance intake (Fig. 3) fell below requirements above 2% (August and January) and 15% (March and May) dietary browse. For lactating cows, intake fell below requirements above about 2% dietary browse.

Browse Characteristics Hinder Cattle Use

South Texas browse species have various defenses that make cattle use difficult or undesirable. For example, blackbrush, a common South Texas woody plant, has small compound leaves and large thorns, up to 2.5 inches long. In an African study, Cooper and Owen-Smith[5] found that large ruminants took fewer and smaller bites when they encountered plant spines and thorns and could not make up for these reductions by grazing longer.

Spiny hackberry or granjeno is considered a valuable browse plant for deer. However, it has small leaves and thorns associated with the stems. Whitebrush has very small leaves, which make it difficult for cattle to eat enough leaf to maintain forage intake. Although coyotillo has large leaves that are not physically protected from browsing animals, the leaves are unpalatable and toxic.

Some South Texas Browse Species	
Common name	**Scientific name**
Blackbrush	*Acacia rigidula*
Coyotillo	*Karwinskia humboldtiana*
Guajillo	*Acacia berlandieri*
Spiny hackberry (granjeno)	*Celtis pallida*
Whitebrush	*Aloysia gratissima*

Guajillo, another common South Texas woody plant, is not physically protected from browsing and has large amounts of readily accessible leaf material. On the surface, guajillo appears to have high nutritional value. For example, in the growing season, it may test 20% crude protein. However, in a Texas study, Barnes et al.[6] found digestible protein levels of around 10% when crude protein levels were at 20%. In another Texas study, Nantoumé et al.[7] found that while guajillo has a high nitrogen content, it has a low true protein content. The difference between crude and digestible protein is a result of nonprotein nitrogenous compounds in guajillo.

Blackbrush (*Acacia berlandieri*) is a common browse species in South Texas. Its small compound leaves protected by spines up to 2.5 inches in length make it difficult for cattle to use as forage.

Guajillo also tends to be low in digestibility. In a white-tailed deer study, Campbell and Hewitt[8] found that nitrogen requirements for growth and antler development could not be met if guajillo made up more than 60% of the diet. Furthermore, energy requirements for maintenance and antler growth could not be met if guajillo made up more than 20% of the diet.

Range Health and Browse Use Are Not Compatible

Cattle in this study did not shift to high levels of dietary browse until grass standing crop was below 500 lb·acre^{-1}. All but one dietary browse measurement above 20% dietary browse occurred at grass standing crops below 500 lb·acre^{-1} (Fig. 4). Most of the more palatable and productive grasses found in South Texas are midgrasses. Forage residue levels below 500 lb·acre^{-1} are below minimum recommended thresholds (750–1,000 lb·acre^{-1}) for midgrass survival.[9] Residual herbaceous vegetation on rangelands adds organic matter to soil, holds water for infiltration into soil, reduces evaporation, keeps soil cooler, and reduces erosion.[9]

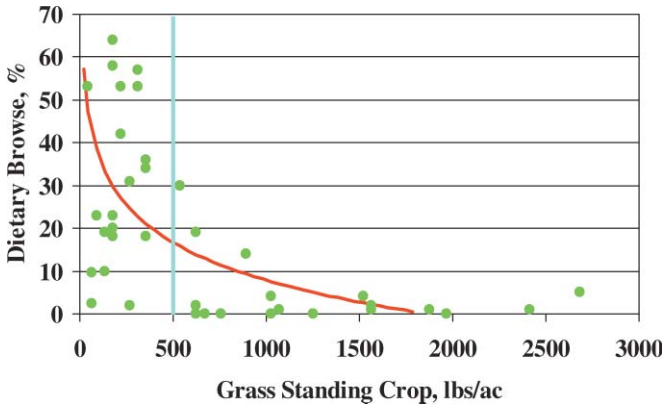

Figure 4. The curved line represents the relationship between grass standing crop and percent dietary browse. Dots represent actual data points. Most data points for dietary browse levels above 20% occurred below grass standing crop levels of 500 lb·acre^{-1}. These grass levels are below minimum recommendations to maintain midgrasses, such as the more desirable and productive grasses in South Texas.

Heavy Browse Use Is a Bad Sign

As browse increased in the diet, our nutritional analyses indicated that cattle would not be able to maintain acceptable levels of performance because both forage intake and forage digestibility declined. As a result, energy would tend to be the first limiting requirement for growing steers or dry and lactating cows.

Because tannins and nonprotein nitrogenous compounds were not measured, diet crude protein values found in this study may be greater than digestible protein values. Therefore, estimates for potential crude protein gain may be overestimated at higher dietary browse levels.

The point at which cattle consumed more than 20% browse corresponded to a forage residue level below 500 lb·acre^{-1}, which is detrimental to range health in midgrass and tallgrass plant communities.

Heavy browse use by cattle in South Texas is a bad sign for both cattle nutrition and range health.

References

1. Hofmann, R. R. 1998. Anatomy of the gastro-intestinal tract. *In:* D. C. Church (ed.). The ruminant animal: Digestive physiology and nutrition. Englewood Cliffs, NJ: Prentice Hall. p. 14–43.
2. Everitt, J. H., C. L. Gonzalez, G. Scott, and B. E. Dahl. 1981. Seasonal food preferences of cattle on native range in the South Texas Plains. *Journal of Range Management* 34:384–388.
3. Stuth, J. W., and R. K. Lyons. 1999. Grazing steer fecal output dynamics on south Texas shrubland. *Journal of Range Management* 52:275–282.
4. National Research Council. 1996. Nutrient requirements of beef cattle. Washington, DC: National Academy Press.
5. Cooper, S. M., and N. Owen-Smith. 1986. Effects of plant spinescence on large mammalian herbivores. *Oecologia* 68: 446–455.
6. Barnes, T. G., L. H. Blankenship, L. W. Varner, and J. F. Gallagher. 1991. Digestibility of guajillo for white-tailed deer. *Journal of Range Management* 44:606–610.
7. Nantoumé, H., T. D. A. Forbes, C. M. Hensarling, and S. S. Sieckenius. 2002. The nutritive value of guajillo as a component of goat diets. Uvalde, TX: Uvalde Research and Extension Center-02-008.
8. Campbell, T. A., and D. G. Hewitt. 2005. Nutritional value of guajillo as a component of male white-tailed deer diets. *Rangeland Ecology and Management* 58:58–64.
9. Hanselka, C. W., L. D. White, and J. L. Holechek. 2001. E-127, Managing residual forage for rangeland health. Uvalde, TX: Texas Cooperative Extension.

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