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Balancing Beef Cow Nutrient Requirements and Seasonal Forage Quality on Annual Rangeland

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Range beef cow nutrition programs are greatly influenced by the changing nutritional needs of a cow as it progresses through the reproductive calendar and seasonal changes in the quality of rangeland forage. Matching the nutrient demands of range beef cows and the nutrients supplied by rangeland forage is a balancing act for a considerable portion of each year for producers of beef cattle who depend on annual rangelands for all or part of their yearly forage supply. This publication is intended to supplement basic beef cow management information in the *Cow-Calf Management Guide* (see Additional Reading) and will be useful to range management professionals, beef cattle producers, and students. Additional cow nutrition and annual rangeland forage quality information is available in *Annual Rangeland Forage Quality* (UC ANR Publication 8022). In this publication we discuss the cow reproduction calendar, several macro- and micronutrients and related deficiency symptoms that may affect beef cows grazing on annual rangelands, and the potential for specific seasonal protein gaps associated with common forage sources.

THE REPRODUCTIVE CALENDAR

Time of calving. There are various ways of looking at the cow reproductive calendar, but one of the best is to divide the 365-day beef-cow year into five stages of production, beginning with calving (Figure 1). The herd manager determines the calendar of operations by selecting the time of calving and thus the time of breeding. Fall calving is a common practice on California's annual rangelands because of mild winters with available green forage. Spring calving is common in regions with more severe winter weather. The major factors that influence the selection of calving time include

- weather conditions
- quality and availability of range forage
- supplemental feed
- labor
- capital inputs
- calf crop production goals (i.e., calving percentage, weaning weights, calving interval)
- relative weights of calves produced in the different calving seasons
- diseases (i.e., foothill abortion, calf scours, etc.)

RE-BREEDING

Cows must re-breed within 80 to 85 days after calving if a 365-day calving interval is to be maintained. The reproductive year of the beef cow (Figure 1) is a very tight schedule if management's objective is to produce a calf each year from each cow. Adequate nutrition is crucial to meeting this objective. The period from conception to birth is about 283 days (Hereford 286, Angus 281). Most cows will not come into estrus until 30 to 45 days after calving; longer if nutrition is poor. Cows come into estrus at 21-day intervals, so it takes 42 days for a cow to become pregnant in two services. From 365 days in a year, subtract 283 days for gestation and another 40 days before first estrus cycle after calving, and you have a window of only 42 days (two breedings) if you are going to stay on schedule for the next year.

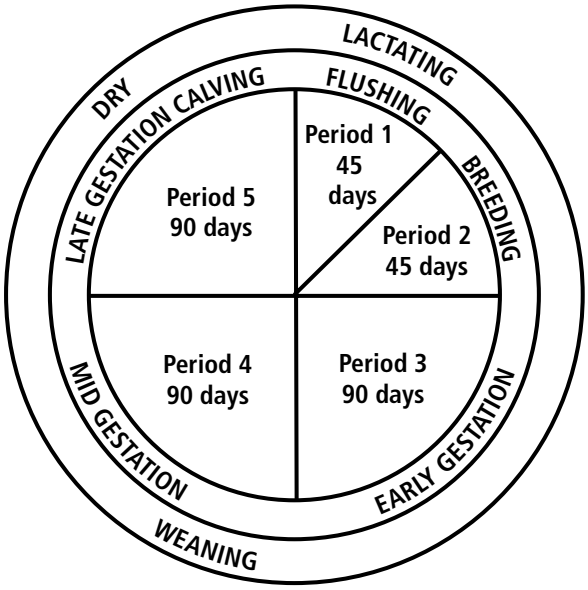

Figure 1.
Beef cow reproduction calendar.

Table 1 shows why it is so difficult to achieve a high percentage calf crop. Under good management, cows bred after their second calf are expected to wean an 80 to 90 percent calf crop. Bred heifers that will remain in the herd must also wean a high percentage of their calves. To successfully breed heifers at one year of age, you need to maintain a high plane of nutrition throughout their first 2 years. While annual range forage provides adequate nutrients during the late winter and spring (*adequate green season*), forage quality in the summer and early fall (*inadequate dry season*) and late fall and winter (*inadequate green season*) is insufficient to maintain this high plane of nutrition. Irrigated pasture, high elevation summer range and meadows, or supplementary feeding is usually necessary to maintain replacement heifer nutrition at an adequate level.

Table 1. Cow herd reproductive success, death loss, and weaning rate.

	Pregnancy rate				Death loss			Weaning rate
Population	First service	Second service	Third service	Open	Embryo loss	Cow loss	Calf loss	Calves weaned
Cows (2nd year +)	64	20	7	9	2	2	2	85
Heifers (1st year)	55	17	8	20	4	2	4	70
Pregnancy-tested cows	68	22	10	0	2	2	2	94

Notes: 17 to 20% of cow herd is replaced annually; for every 4 bulls there are 100 cows; 25% of bulls are replaced annually (death loss 9%, culled 16%); calves weigh 75 pounds at birth and gain 1.4 pounds (heifers) and 1.6 pounds (steers) per day until weaning (about 45 pounds per month).

Even if cows are checked for pregnancy after the breeding season and open cows are sold, one is lucky to have a calf crop of more than a 94 percent. A typical cattle operation will replace 10 to 20 percent of the cow herd each year. Bulls are generally replaced at a 25 percent rate. Four bulls per 100 cows is typical. Fewer are needed in intensive operations, more on rough terrain. Calves weigh about 75 pounds at birth and typically gain 1.4 lb (heifers) and 1.6 lb (steers) per day to weaning age of 7 to 10 months, or about 45 lb per month.

Calves after weaning vary greatly in gain on the range. Most operators expect at least 200 lb gain on a weaned calf (commonly called a stocker calf) during the green season. Most of the gain is during the spring. Yearlings gain better on range than freshly weaned calves.

COW CONDITION

Cow condition at the time of calving is an important factor determining how quickly after calving a cow returns to estrus. By monitoring their cows' body condition, producers can adjust feeding levels to ensure an adequate re-breeding rate. Body condition scoring assigns a numerical value of 1 (very thin) to 9 (very fat) depending on the degree of body fat reserves visually observed. Experience and research have shown that mature cows should be at a condition score of 5 or 6 at calving, while first-calf heifers and second-calf cows should be between 6 and 7. Body condition scoring is discussed by Momont and Pruitt (1999) and in numerous textbooks.

COW NUTRIENT REQUIREMENTS AND FORAGE QUALITY

Nutrient requirements for a 1,000 lb cow over five stages of production are presented in Table 2. The nutrients that you should consider as potentially deficient in foothill rangelands of California are energy, protein, phosphorus, calcium, magnesium, sodium chloride (salt), potassium, certain trace minerals, and vitamin A (Table 3). You can identify potential nutrient gaps in seasonal forage resources by comparing seasonal cow nutrient requirements with seasonal forage quality. Figures 2 through 5 describe protein requirements and forage protein content to help you identify potential protein nutrient gaps. Protein requirements for fall and spring calving cow herds are superimposed on the forage protein content in these four figures (NRC 1984). The protein percentages in these figures are adequate only if there is sufficient forage to meet the animals' daily forage dry matter intake requirements.

Table 2. Nutrient requirements for a 1,000 lb beef cow.

	Stage of production				
Nutrient	**Period 1: calving (45 days)**	**Period 2: breeding (45 days)**	**Period 3: early gestation (90 days)**	**Period 4: mid gestation (90 days)**	**Period 5: late gestation (90 days)**
Dry matter (lb)	20.60	21.00	19.50	18.10	19.60
Protein (lb/day)	2.50	2.60	2.00	1.30	1.60
TDN (lb)	13.80	14.00	11.50	8.80	10.50
Calcium (g/day)	36.00	38.00	25.00	15.00	23.00
Phosphorus (g/day)	25.00	27.00	20.00	15.00	18.00
Vitamin A (x 1,000 IU)	37.00	38.00	36.00	25.00	31.00

Source: National Research Council 1984.

Table 3. Nutrients that have the potential for deficiency in forage on California foothill rangelands.

Nutrient, and potential for deficiency	Deficiency symptoms*
Energy Energy, often measured as total digestible nutrients (TDN), Net Energy for maintenance (NEm), Net Energy for gain (NEg), Digestible Energy (DE), or Metabolizable Energy (ME), is the most important nutritional factor to consider for beef cows for several reasons. It is the nutritional factor most commonly lacking due to the shortage of forage. Were it not for energy, the nutrient requirements of the beef cow could be met by 2–4 lb of total feed per day. Insufficient energy intake may occur when cattle are forced to graze deficient dry forage in the fall (inadequate green season). *During this period low forage levels (<800–1,000 lb/a) and low palatability may reduce intake, restricting the animals' ability to meet their daily dry matter requirements for energy, protein, and other nutrients.*	Retarded Delayed sexual maturity Poor conception rate Shortened lactation period Decline in milk yield May be complicated by protein, mineral, and/or vitamin deficiency Loss of body weight Failure to conceive Lowered resistance to diseases and parasites Increased mortality (toxic plants)
Protein Protein is the nutrient most likely to be lacking in summer and fall diets when dry forage is plentiful but green forage is not adequate. Supplemental protein for wintering cows is usually the largest cash expense in the yearly costs of maintaining a cow. Supplements such as cottonseed and safflower oil meal are primary sources. Urea is a non-protein compound that ruminants may convert to protein with varying degrees of efficiency through the action of microorganisms in the rumen. The use of liquid supplements and blocks has increased drastically over the past few years and will continue to increase as research provides information in efficient formulations including urea. Proper management procedures are important when urea is fed to prevent ammonia toxicity and to enhance urea utilization.	Reduced appetite Reduced growth rate (fetus and calf) Loss of weight Inadequate intake of other nutrients Delayed estrus Irregular estrus Poor conception rate Reduced milk production
Calcium Calcium usually is not a serious problem in beef cow diets. It seldom is deficient in California range forage.	Poor growth Depletion of calcium Swollen, tender joints Arched back Stiffness Deformed legs Fractures
Phosphorus Phosphorus may be borderline to definitely deficient in range cow diets during summer, fall, and winter periods in California. When high-protein and liquid supplements are fed, they usually supply adequate phosphorus to supplement native forage.	Decreased appetite Chewing wood, bones, and hair Low blood phosphorus Stiff joints and lameness Decreased milk production Failure to show estrus Poor conception rates (open cows) Retained placenta
Salt (sodium chloride) Salt should always be provided free choice in loose-pack or block form. The placement of salt away from water is a common practice for improving stock distribution and achieving better range utilization.	Licking and chewing various objects Loss of appetite Unthrifty appearance Rough haircoat Decreased milk production Reduced gains Lack of coordination Weakness Death

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Table 3. Nutrients that have the potential for deficiency in forage on California foothill rangelands *(continued)*.

Nutrient, and potential for deficiency	Deficiency symptoms*
Magnesium Under California conditions grass tetany or hypomagnesemic tetany often occurs. It is a major problem, especially in lactating cows grazing lush, rapidly growing pastures highly fertilized with nitrogen during cool foggy or cloudy seasons. Grass tetany can be prevented by providing 8 grams of magnesium per head per day prior to onset of symptoms. Magnesium nutrition may be complicated by addition of urea to the diet.	Uncoordinated gait Convulsions Coma Death
Potassium Generally, forages contain more potassium than beef cows require. However, potassium concentration decreases with advancing maturity of forage and can be reduced further by leaching.	Decreased feed intake Decreased milk yield Reduced weight gain Muscular weakness
Trace minerals Deficiencies of trace minerals such as copper, zinc, iodine, and selenium exist in many areas of California. Trace mineral deficiencies in California are localized, and because their effects can be insidious and substantial, producers may want to obtain recommendations from a local authority such as a Farm Advisor or veterinarian. Selenium deficiencies are concentrated in northern (especially northeastern) California. Selenium can be administered as an injection. In deficient areas, selenium provided in supplement blocks has generally proved ineffective at the 30 ppm level.	**Copper deficiency:** Change in hair color, rough hair coat, depression in weight gain, bone fractures, and anemic appearance. Cows coming back into estrus due to early embryo death. **Iodine:** Goiter. **Selenium deficiency:** White muscle disease, retained placentas, reduced gains, unthriftiness, and diarrhea.
Vitamin A Vitamin A deficiencies occur in beef cow herds in California. A cow stores up a several-months' supply in her liver during the adequate green feed period, but this supply can be depleted rapidly in a lactating cow. Vitamin A deficiencies may also occur in fall calves during dry years or in young cows. Supplemental vitamin A should be provided by: 1. addition to a protein supplement; 2. intramuscular injection (1 million IU will last 3 months); 3. addition to a mineral mix.	Watery eyes Night blindness Scouring Respiratory infection Poor conception Abortion-shortened gestation period Birth of dead, weak, or blind calves Retained placentas Uncoordinated calves Poor conception rate

*Source: Merck and Co. 1998.

Figure 2 compares forage protein content for a normal year to that for years when the fall rains are delayed (*dry fall*) or the rainy season ends earlier than usual (*early dry season*). These two examples result in an extended dry season characterized by reduced protein content in the available forage. Figure 3 compares monthly forage protein for a normal year and for years when early fall rains result in an early green season or extended spring rains result in a long green season. These two examples result in a longer than normal green season with higher protein contents in the forage. Mountain meadows and irrigated pasture are two common forage alternatives that are used by ranches on annual rangeland to provide summer green forage (Figures 4 and 5). While protein content in a typical Central Valley irrigated pasture will usually exceed cow protein requirements throughout the summer, the protein contents of mountain meadow forage may not be adequate in the late summer and early fall.

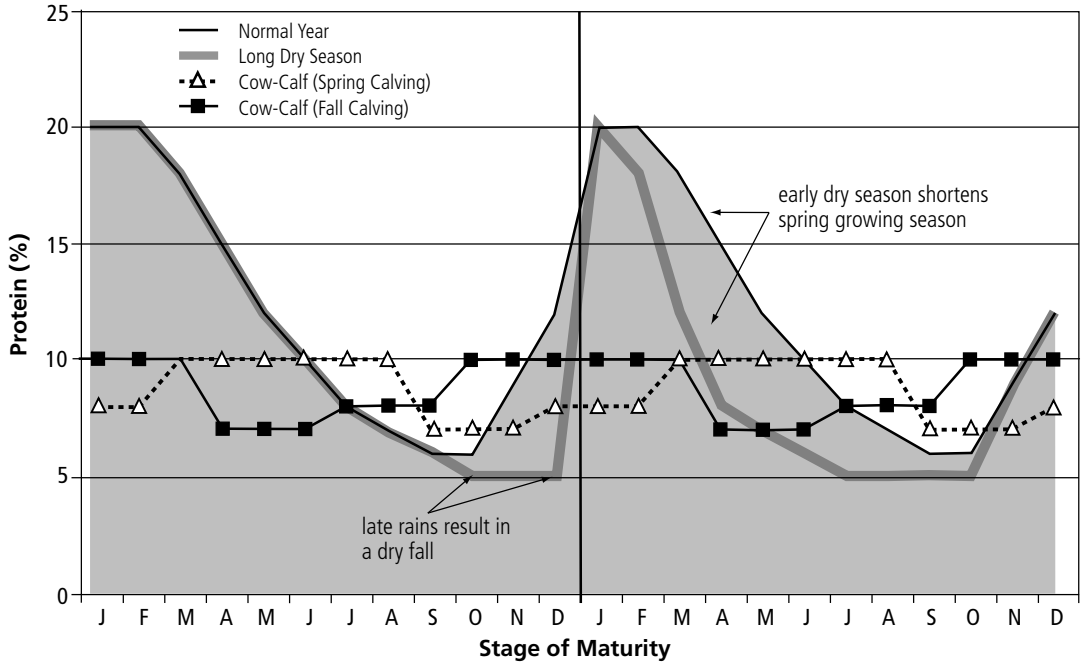

Figure 2.
Examples of annual rangeland forage protein for a normal year, a year with a dry fall, and a year with an early dry season, with cow protein requirements for fall- or spring-calving cows superimposed.

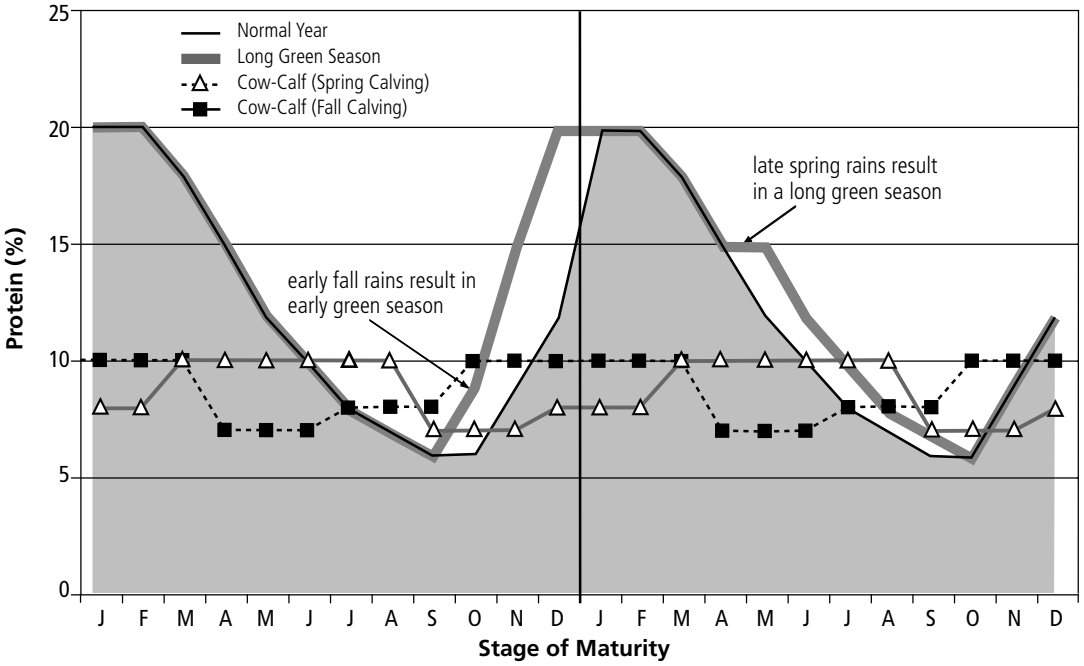

Figure 3.
Examples of annual rangeland forage protein for a normal year, a year with an early green season, and a year with a long green season, with cow protein requirements for fall- or spring-calving cows superimposed.

In addition to seasonal changes in forage quality, forage nutrient concentration can also vary greatly across the landscape. Forage dries sooner on south-facing slopes. Springs, seeps, and swales may remain green longer than surrounding vegetation. Nutrient concentration is higher in leaves and twigs from woody vegetation than in surrounding dry forage.

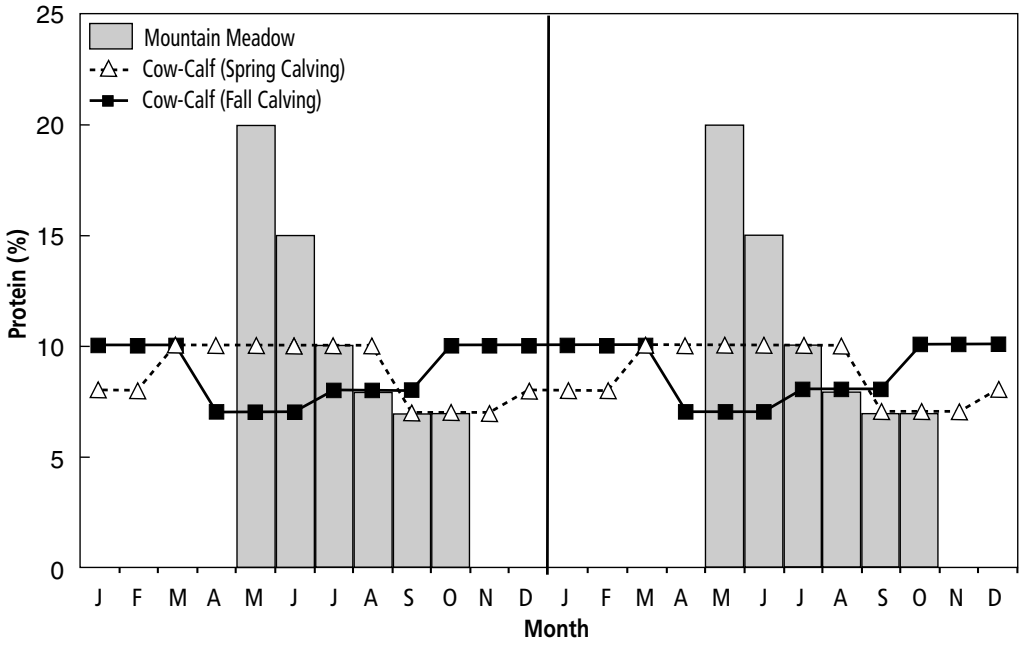

Figure 4.
Example protein content for a mountain meadow, with cow protein requirements for fall- or spring-calving cows superimposed.

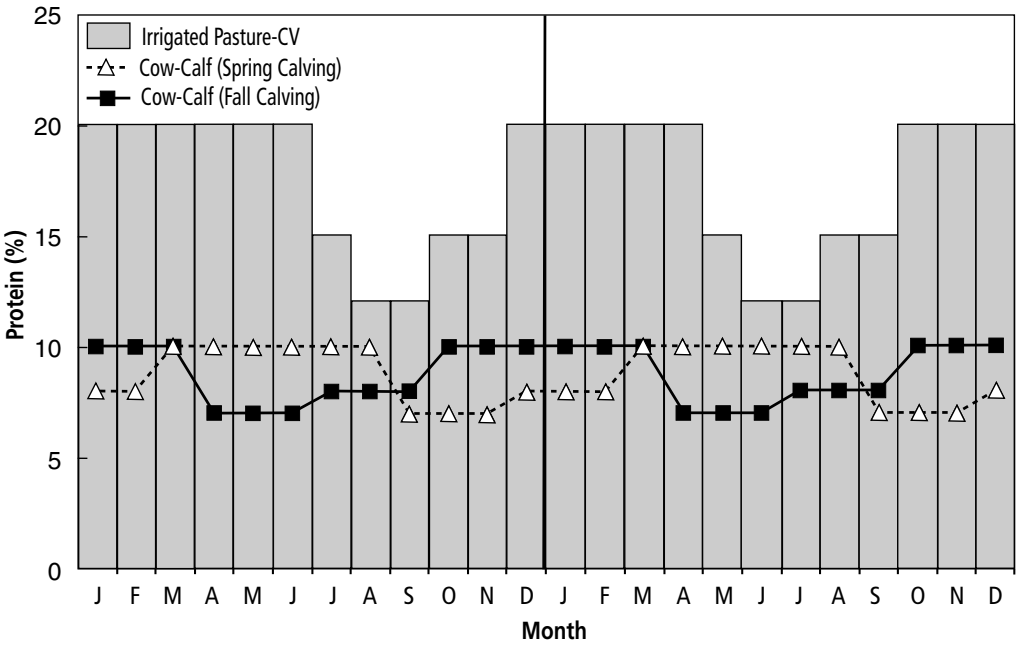

Figure 5.
Example protein content for a Central Valley cool-season irrigated pasture, with cow protein requirements for fall- or spring-calving cows superimposed.

Ruminant animals are selective grazers and seek out and remember the location of nutrient-rich patches. Consequently, they usually select a higher-quality diet than that represented by forage samples collected by hand. The comparisons illustrated here are only examples of forage protein content that can in reality vary widely in time and space. Consequently, each operation must develop its own unique range livestock nutrition program.

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