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Nutritional and Managerial Considerations for Range Beef Cattle Production

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Rangeland, which covers over 1 billion acres (400 million ha), excluding Alaska, makes up the largest classification of land area in the continental United States. This represents 54% of the land area and consists of grasslands, shrublands, and open forest. This land mass under current management practices is estimated to supply forage for over 200 million animal unit months. This supplies over one third of the total forage required by the nation's beef herd in addition to forage for other domestic and big-game species. Rangelands contribute to the food supply of people in only one way and that is by providing feed for grazing animals. The majority of these rangelands lie in the 17 western states. In addition there are approximately 1 million acres (40 million ha) of native meadow hay in the western United States.

These rangelands and native meadows are extremely heterogeneous in nature and represent the most variable commodity that is encountered in livestock nutrition and management. Soil type and depth, annual and seasonal precipitation, temperatures, altitude, topography, ecological sites and management of these lands all contribute to their variability. Much of the data presented here were collected on the Eastern Oregon Agricultural Research Center, located in southeastern Oregon. This rangeland and meadowland is closely related to much of the ranges and meadows in the western United States. These data and general principles can be extrapolated and applied to grazing animals on forages anywhere in the world.

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Livestock operators can usually tell you the nutritive value of grains, supplements, hay, or other feedstuffs they purchase, but few have a clear understanding of the value of forages they graze and how they change over time. This discussion will identify the nature of range feed, including nutritive value of forages throughout the year, nutrient needs of the livestock and the relationship of these nutrient needs to the nutrients the various classes of cattle can get from the forage base. Discussions will include managerial manipulations that strive for optimum range livestock production and supplemental feed strategies, options beyond economic supplementation, time of calving, time of weaning, producing slaughter animals on range, and other strategies for improving efficiency of range operations. Parasite control, implanting, feed additives, routine herd health practices, and many other factors involved with good animal management are important for optimum production but outside the scope of this article. Obviously, with all of these alternatives we need to practice good "range management" to maintain range condition and consider the effects on wildlife. This discussion will not include range management techniques, such as removing brush, fertilizing, grazing systems, etc., for increasing or improving range forages, or the effects of the management schemes on wildlife.

DESCRIPTION OF THE AREA WHERE THE BASIC RESEARCH WAS CONDUCTED

Grazing regions of the western United States have been divided into three distinct units based on seasonal precipitation patterns.[15] The Great Basin pattern lies between the Rocky Mountains and the Sierra Nevada and Cascade Mountains and is characterized by primarily winter and spring precipitation and moisture-deficient summers. The Southwestern pattern, including Arizona, southern Utah and Nevada, and parts of New Mexico, is biseasonal and is characterized by winter precipitation followed by spring drought and summer precipitation followed by fall drought. The Plains pattern occurs in the area bounded on the west by the Rocky Mountains and on the east by the Appalachian Mountains. Precipitation in this area is greatest in the spring and summer and then tapers off in the fall and winter.

Common ecological units within the Great Basin pattern are the sagebrush-bunchgrass of the lower elevations, where much of the data that will be presented have been collected, and coniferous forest communities in the mountains. There are approximately 20 million acres of sagebrush-bunchgrass rangeland in eastern Oregon alone. This region also contains extensive riparian and flood meadow areas.[30] The northern intermountain region alone contains nearly 1 million acres of native flood meadow bordering local streams and lakes.[7] The Eastern Oregon Agricultural Research Center, Squaw Butte Range, is typical of much of the sagebrush steppe of the Great Basin, and the hay meadows are typical of native meadows throughout the region.

The Squaw Butte Range is in the Payette section of the Columbia Plateau at an elevation of 4600 feet (1400 m). The soils are mostly sandy loams of basaltic origin underlain with a calcium carbonate layer varying from 2 to 4 feet (0.6 to 1.2 m) below the surface.[11]

The climate is characterized by cold winters, hot summers, and low precipitation levels, arriving mainly during the winter. Average annual precipitation is 11.7 inches (29.7 cm). About 60% occurs as snow during the fall and winter and only 25% as rain during the growing season in the spring and early summer.[13] The combinations of late spring and early fall frosts, and limited amounts of precipitation during the warmer months result in short grazing seasons and permit only one growth cycle, resulting in all grass forage species maturing at about the same time with little difference in nutritive value between species.

Shrubs form a major component of desert range vegetation. Woody vegetation is primarily Wyoming big sagebrush (*Artemisia tridentata* subsp. *wyomingensis*), low sagebrush (*Artemisia arbuscula*), and juniper (*Juniperus occidentalis*). Other shrubs found in the region include several other sagebrush species (*Artemisia tridentata* spp.), bitterbrush (*Purshia tridentata*), green rabbitbrush (*Chrysthamnus vascidiflorus*), and gray rabbitbrush (*Chrysthamnus nauseous*). Except for bitterbrush, the shrub species of the basin are not palatable to cattle.

Herbaceous vegetation consists of cool-season grasses, primarily of native species bluebunch wheatgrass (*Agropyron spicatum*), Idaho fescue (*Festuca idahoensis*), sandberg bluegrass (*Poa sandbergii*), squirreltail (*Sitanion hystrix*), thurbers needlegrass (*Stipa thurberiana*), and several other species of stipas. Introduced grass species include crested wheatgrass (*Agropyron desertorum*) and cheatgrass (*Bromus tectorum*).

Elevation of the Harney Basin, which encompasses the native flood meadows, is 4100 feet. This is a wide alluvial plain typical of native flood meadows. Soils of the area are generally silt loams and are mildly calcareous and slightly alkaline. The area is irrigated by wild flooding in the spring for a period from 6 to 12 weeks, usually starting in April. Active growth ceases within 2 to 3 weeks after recession of flooding.

Vegetation consists of as many as 100 species; however, over half of the biomass is made up of rushes (*Juncus* spp.) and sedges (*Carex* spp.).[7] The principal sedge is rusty sedge (*Carex subjunca*) and the dominant rush is baltic rush (*Juncus balticus*). The remaining 25% consists of grass and shrub species. The most abundant grasses are Nevada bluegrass (*Poa nevadensis*), meadow barley (*Hordeum brachyantherum*), meadow foxtail (*Alopercurus pratense*), and beardless wildrye (*Elymus triticoides*). The principle clover species is annual whitetip clover (*Trifolium variegatum*).

TYPICAL GAINS OF CATTLE THROUGHOUT THE GRAZING SEASON ON RANGE

Livestock weight gains on range diminish dramatically as the grazing season progresses and plants mature. With the precipitation pattern allowing only one growth cycle on forages in the Great Basin, there is only one period of high nutrient value and rapid gain during the year. This occurs in late spring and early summer and essentially dictates a situation in which, without forage or livestock management manipulation, there is a period of 3 months of high forage quality and animal performance and 9 months of poor quality feeds and poor livestock production.

Typical gains of suckling calves and yearlings on range are presented in Figure 1.[18] Gains peak between May 15 and June 10 and exceed 2 pounds (0.9 kg) per day during this time and drop off rapidly over time. Figure 2 presents typical gains of fall- and spring-calving cows, with parturition occurring during October to November and March to April, respectively.[16] The same pattern is displayed, with extremely high weight gain early in the grazing season and eventual weight loss by late summer and early fall. Most of the data were collected on crested wheatgrass seeding, but gain response to grazing is essentially identical on native species. For management reasons, crested wheatgrass seedings need to be fenced off and managed separately from native ranges, primarily because of differences in preference. Native flood meadows provide for somewhat higher gains, but the general trend is the same.[8]

The gain patterns presented in Figures 1 and 2 are simplistic and represent a composite over many years. There are many factors that affect these responses. Previous winter nutrition and management, quality of cattle, yearly climate patterns, condition of animals, etc., will modify the actual gain within a given time frame. Cattle grazed at lower elevations will shift the gain charts to the left and higher elevation vice versa, but the trend remains the same. Management schemes to allevi-

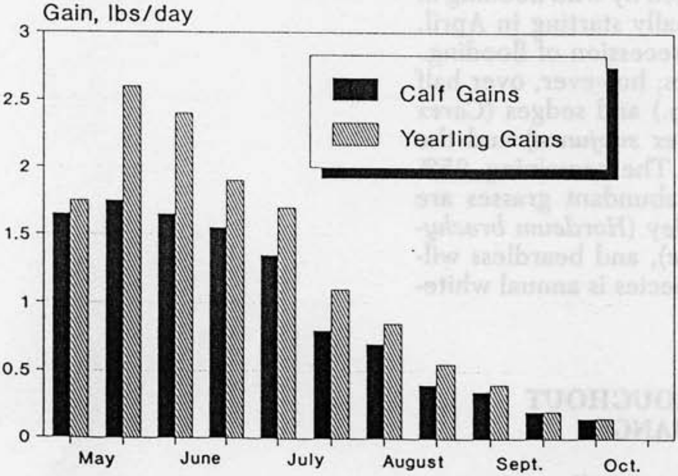

Figure 1. Typical weight gains of sucking spring-born calves and yearlings on sagebrush-bunchgrass range.

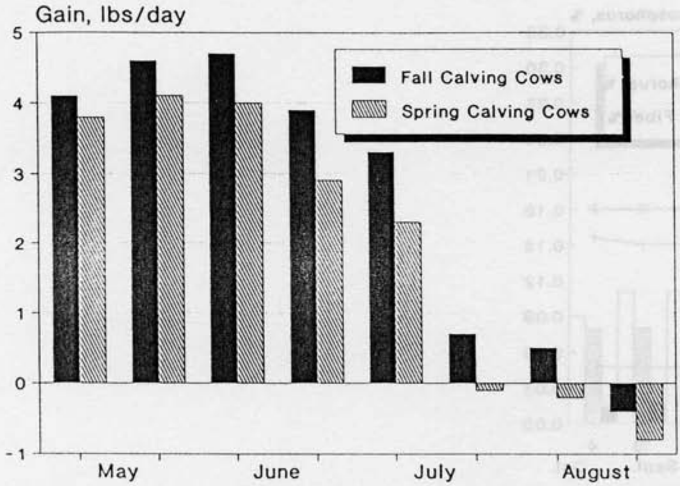

Figure 2. Weight gains of lactating cows on sagebrush-bunchgrass range.

ate poor production over much of the year will be dealt with in subsequent sections.

NUTRITIVE VALUE OF RANGE FORAGES THROUGHOUT THE GRAZING SEASON

The gain data presented in the previous section are a direct reflection of the nutrient value of the range forages. These values are dependent on elevation, yearly climatic factors, and diversity of the forage base. As with the gain data, the general trend of forage quality throughout the grazing season will be presented and represents a composite over many years.

Concentration of certain chemical constituents of range forages are shown in Figure 3.[18] The critical nutrients, protein, energy, and phosphorus all decline as the grasses mature and cell wall constituents increase. The precipitation pattern permits only one growth cycle, resulting in all grass species, native or introduced, maturing at about the same time with little difference in quality between species. Supplementing minerals and vitamins will not substantially improve performance. However, if grazing is in a deficient area, then these minerals need to be supplied. Mineral content of plants varies considerably from one area to another. Other than phosphorus, minerals that can be deficient or, in some cases, excesses can occur, are magnesium, potassium, copper, zinc, selenium, and cobalt. Mineral nutrition problems are very localized and need to be evaluated on that basis. Vitamins A and E are the only vitamins of concern. Vitamin E deficiency is not commonly recognized and vitamin A deficiency is only a problem if on dry bleached feed over a period of 6 months or more.

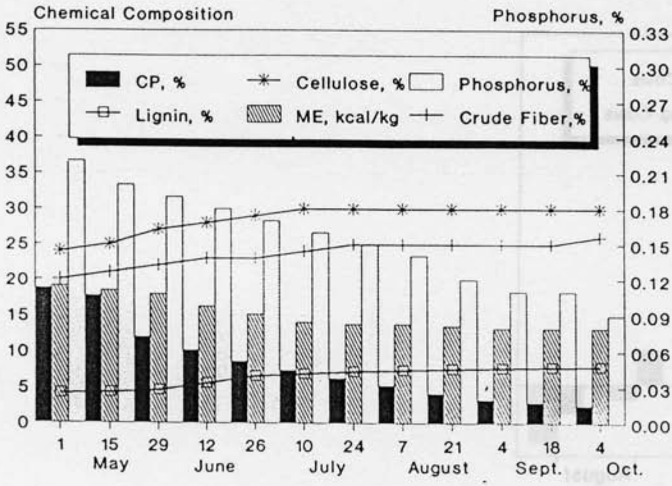

Figure 3. Chemical compositions of range grasses.

In addition to the reduction of nutrient content of the forage, the declining nutritive value to livestock is compounded by declining availability of the nutrients as shown by digestibility values in Figure 4.[18] This slows rate of passage and consequently total forage intake, which leads to poor livestock performance.

Browse, woody-stemmed perennials, and forbs, usually hollow-stemmed annuals, including most weeds, also make up an important component of range feed. Browse is generally higher in protein and

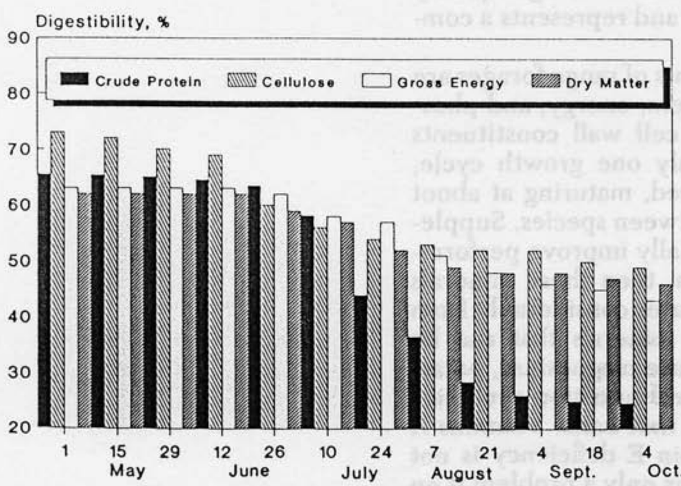

Figure 4. Digestibility of chemical components of grasses in range cattle diets.

lower in energy than grasses, with forbs exhibiting both seasonal and yearly variation, making them unpredictable with regard to availability and quality (Fig. 5). Browse and forbs are much more important in wildlife and sheep diets than in those of cattle, with cattle diets typically containing little to none of these forages. However, under certain conditions of availability and quality of grasses, as compared to the browse and forbs, they can become an important component of the diet.

NUTRITIVE REQUIREMENTS AS RELATED TO ANIMAL CAPABILITY TO OBTAIN NUTRIENTS FROM THE FORAGES

Nutrient requirements of various classes of livestock at different stages and levels of production can be fairly accurately determined from guidelines.[17] This information, in conjunction with the nutrient content and digestibility data presented in the previous section and determining the voluntary intake of grazing animals allows us to estimate the relationship between the animal's needs and what it can get from the forages. Energy expended for travel will increase requirements for range animals somewhat over small pasture or confinement feeding, but this can be calculated. Otherwise requirements are the same. Gathering data to make these needed evaluations involves laborious and expensive techniques such as chemical analyses of forages, digestibility determination either in vitro or in vivo, or fecal output for intake estimates and often employs rumen and esophageal fistulated animals, internal markers, or a wide array of other techniques described in various publications.[5,6,14] The recent development of boluses

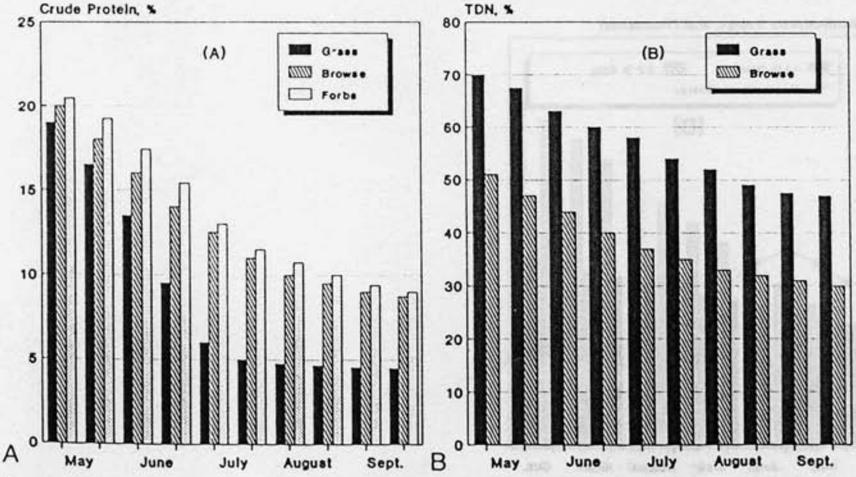

Figure 5. Crude protein content of grasses, browse, and forbs (*A*), and TDN content of grasses and browse (*B*) at various dates during the grazing season.

containing external indicators such as chromic oxide for estimating fecal output will help make gathering of these data more practical. Data of this nature that have been collected in a research unit or other rangelands can be applied to many other situations.

Figure 6 presents the digestible nitrogen and metabolizable energy yearling steers can obtain from range forage and the requirements to gain 2.2 (1 kg) or 1.1 pounds (0.5 kg) per head per day. Protein for either level of gain is becoming limited by late June to early July whereas energy becomes limiting by late June on the higher level and mid July on the lower level.

Digestible nitrogen and metabolizable energy that mature cows can obtain from range forage are presented in Figure 7. The protein deficiencies occur at about the same time as with the growing animals for lactating cows and a little later for gestating cows. Phosphorus deficiencies occur at about the same time as protein for all classes of animals. The lactating cow is short of energy by late July, with the gestating cow capable of meeting her energy requirements throughout the grazing season.

PRESCRIPTION SUPPLEMENTAL LEVELS TO FILL VOID BETWEEN ANIMAL'S REQUIREMENTS AND NUTRIENT INTAKE

Supplemental feed is employed when nutrients from the forage base become insufficient or inadequate for the level of production desired. Due to economic considerations, supplementation under western range conditions is usually centered around feeding a minimum amount of concentrates to supply the deficient nutrients. Substituting

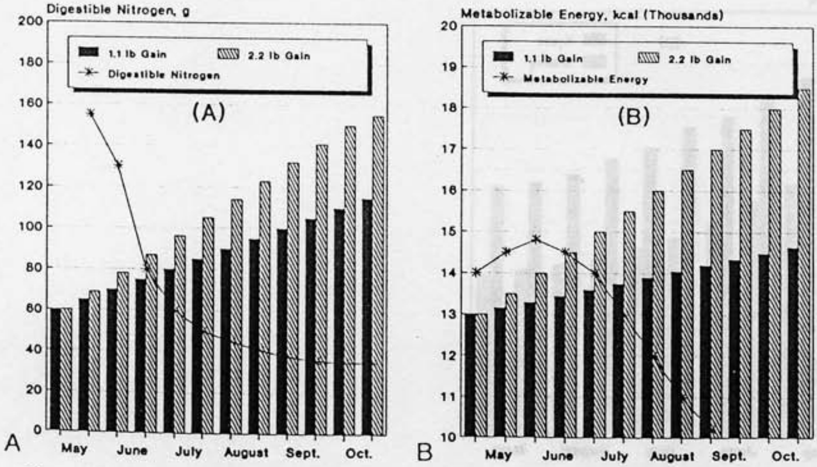

Figure 6. Digestible nitrogen (*A*) and metabolizable energy (*B*) requirements for 550-lb yearling steers and the amount of each derived from range forage.

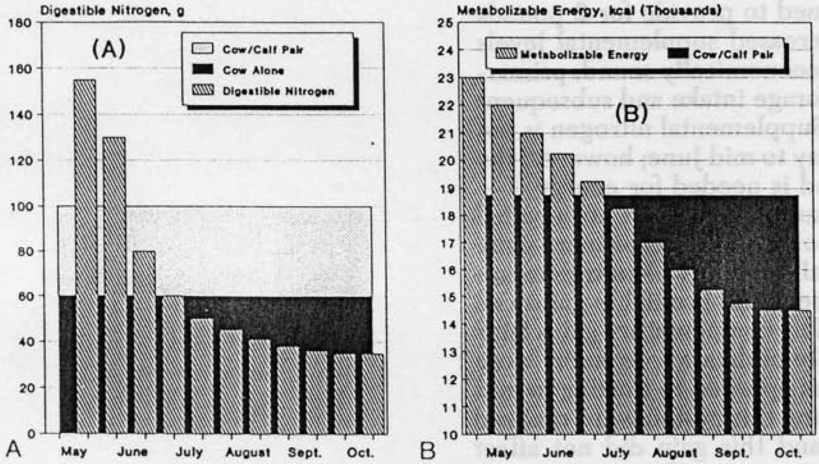

Figure 7. Digestible nitrogen (*A*) and metabolizable energy (*B*) requirements of lactating cows and the amount of each derived from range forage.

supplements for forage is, under most conditions, a costly practice. Forage availability should be adequate to provide maximum intake to negate substituting and also of high enough quality to at least provide maintenance and some gain for growing animals to make the supplement program profitable. In general, the higher the quality of forage, the more efficient and profitable the supplements. Obviously there are situations in which low quality forages must be supplemented to maintain animals.

A typical prescription supplement schedule for yearlings on range is presented in Figure 8.[33] This schedule is derived from the data

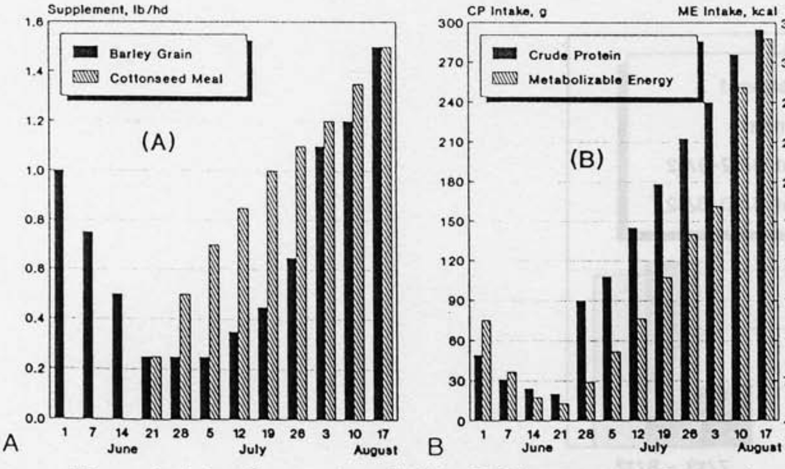

Figure 8. *A*, Supplementation schedule. *B*, Subsequent nutrient intake.

presented in previous figures and is designed to provide for 2 pounds (0.9 kg) daily gain on yearling steers. Increased supplemental levels above those shown have not proved to be economically sound, primarily because of increased costs, decreased forage intake and subsequent diminishing return from the supplement. Supplemental nitrogen is not necessary between turnout date in early May to mid June; however, the barley produces the amounts indicated and is needed for energy.

Previous figures would indicate that supplements are not needed during May and early June to maintain 2 pounds (0.9 kg) or more daily gains on yearling steers. However, if small amounts of nutrients are provided during this time, extremely efficient and profitable gains can be realized and these gains are not negated by compensatory gains later in the season. Figure 9 presents a composite of data where steers were supplemented from turnout in early May as opposed to starting in mid June. Increases of 0.4 pounds (0.2 kg) during this period were realized over those not receiving a supplement and this gain did not affect subsequent gains throughout the summer. Responses from energy supplementation in early spring, despite forage nutrient values being very high, may be attributed to the relatively high moisture content of the forage, which tends to limit dry matter consumption, an imbalance of protein and energy, slowing of rapid passage which decreases digestion and absorption by the host animal, or providing nutrients while adaptation to a new feedstuff via shifting of microbial populations occurs. Most of the protein of immature lush plants is in the form of nonprotein nitrogen and the supplemental energy source may be providing carbon chains for use of this form of nitrogen or the nitrogen contained in the concentrate may be providing by-pass protein. Data indicate that, because of decreasing forage quality, it is impractical to supplement for economic production beyond the middle of August.[33] Beyond this

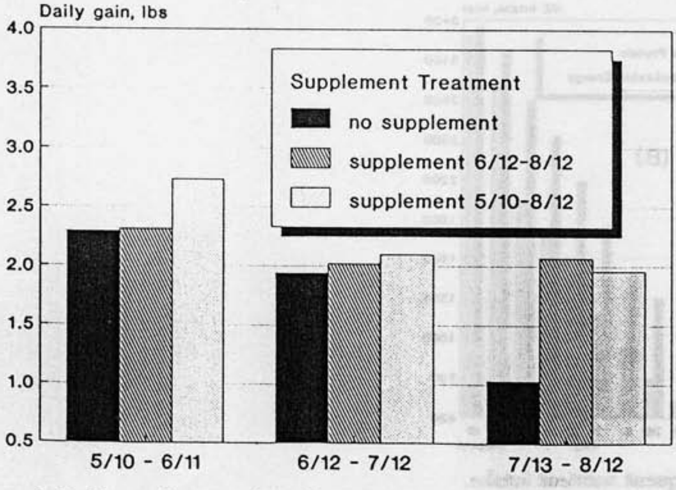

Figure 9. Daily weight gain of yearlings on different supplement treatments.

point, an increased supplement level inhibits forage intake and substitution rather than supplementing nutrients occurs.

These supplements were hand fed on a daily basis with adequate trough space to allow all animals to eat at the same time. For training of animals to the supplement and not reducing grazing time and subsequent forage intake, time of supplementation and setting up of a routine time and method to establish optimum grazing behavior also improves performance.[1] The gain response is under continuous grazing and high pasture use. By grazing half or less of the available forage, typical gains have been 2.6 to 3.2 pounds (1.2–1.5 kg) per day.[9] The cow herd can then follow the yearlings and use the remaining forage.

Gains on summer range vary considerably, depending on forage quality, quality of cattle, previous winter gain, management grazing systems and many other factors. Over the years, yearlings on Squaw Butte have had average gains of 1.2 to 1.8 pounds (0.5–0.8 kg) per day during the summer without supplements and 2 to 3 pounds (0.9–1.4 kg) with daily supplements. In the foregoing examples, supplemental protein was provided from cottonseed meal and energy from rolled barley. However, as long as protein and energy are provided, many different feedstuffs can be used with similar results. Nonprotein nitrogen sources, such as urea and biuret, under proper conditions, have resulted in gains approaching or equaling those with cottonseed meal, as long as the energy provided by feeding cottonseed meal was replaced by barley or other energy sources.[22] Nonprotein nitrogen is not effective with low quality forages unless additional energy is provided. However, care should be taken when urea is fed because of palatability and toxicity problems.[3,4] Urea supplements should be thoroughly mixed and precautions taken to insure that individual animals do not get more than their share. The concentration of urea in the diet is critical. Biuret, a condensation product of urea, essentially two urea molecules hooked together, releases nitrogen more slowly and is less toxic.

Creep feeding on summer range has been marginally effective. Under certain conditions it will pay but often does not. Likewise, supplementation of the cow herd during the traditional grazing period has not been practical or profitable under range conditions. Even in situations in which cows lose weight on range, they recoup losses when moved to meadow aftermath (forage), higher elevation range, rakebunch hay, or other fall feed prior to severe weather conditions of winter.

In general, unless in an area where specific minerals or vitamins are known to be deficient, minor nutrients are adequate. However, a good phosphorus source should be available to animals at all times, regardless of the management program. Two-compartment salt boxes with plain or trace mineral salt on one side and a 50–50 mix of salt and a phosphorus source on the other side have worked well. Intake of the phosphorus is low when forage phosphorus levels are high and high when forage phosphorus levels are low. Care must be taken, though, to monitor intake to provide enough phosphorus, but not allow excess consumption, because phosphorus is an expensive supplement.

The supplement programs described to this point have involved daily feeding of animals. They are not always practical or possible, particularly on the large expanses of western rangeland. For one reason or another, many producers cannot or will not feed a supplement unless it can be fed free choice at infrequent intervals. Supplemental programs based on free choice with controlled consumption of the supplement are desirable. Many vehicles for feeding supplement ad lib have been tried, including blocks, pellets, salt-limiting mixes, liquid feeds, etc., but none has been totally satisfactory in terms of controlling intake at the desired levels. Supplementation at the proper level enhances intake up to mid August, but additional feed decreases forage intake.[25]

Every other day and every fourth day energy supplement regimens have been tested against daily supplementation with gain reduced by one-fourth to one-half pounds (0.1–0.2 kg) per day on the alternative feeding. Late July and August gains were reduced by as much as 1 pound (0.5 kg) per head per day as compared to daily feeding.[33] These data indicate that a method of feeding supplements must be devised so that animals receive their supplements daily. Up to weekly supplementation of adequate amounts of protein, phosphorus and many other minerals and vitamin A has generally been shown to be sufficient. However, energy needs to be supplied daily for the most efficient conversion by the animal.

Salt has been used to control intake of supplements since the early 1930s with varying success. Salt levels have to be continually adjusted and in some cases exceed 50% to adequately control intake. Daily intake of salt has exceeded 2.5 pounds (1.1 kg) per day without ill effects,[26] but the use of salt to control intake seems to consistently reduce daily gains as compared to hand feeding.[33] Also, salt consumption is hard to predict with any great accuracy. It varies from year to year, day to day, pasture to pasture, animal to animal, etc., and depends on forage quality, quantity, type, maturity, and other factors such as previous salt consumption and weather. Salt content of the feed and water also have an effect. Adjustments on these types of supplement programs have to be made frequently, and it is very difficult to get a consistent daily intake of supplement at the levels desired. Although salt does work in some situations, it certainly is not the answer to controlling intake.

Feeding molasses as a supplement to cattle has been practiced since 1850, and urea with molasses since about 1950. Liquid feeds offer many benefits, including improved feed palatability and masking of undesirable flavors, consistent distribution of urea, high phosphorus availability, less waste, convenience, accessibility, and for mixing of top dressings, improved feed penetration, improved feed texture, and reduced dust and wind loss. Liquid feeds also serve as a vehicle for feeding medicaments, vitamins, minerals, antibiotics, and other feed additives. Liquid supplements are easily mechanized, with materials being handled by pumps from tanks, which allows rapid dissemination with little hand labor.

Problems connected with liquid feeds include controlling the consumption level on a herd basis, uniform consumption by individual animals, difficulty in maintaining uniformity of product, equipment cost, and weather changes, particularly cold weather, which can disrupt intake patterns. Overconsumption of urea-molasses products caused by lack of feed, ice or snow covered feed, insufficient water, letting cattle have access to liquid feed prior to feeding hay, etc., can be a major problem and cause digestive disturbances, diarrhea, inefficient animal performance, and possibly death. Calcium can be a problem ingredient, particularly in feedlots, because it is not soluble and is difficult to suspend in liquids. Urea is often used because amino acids and/or natural proteins are difficult to suspend. High levels of phosphoric acid or salt, used for intake control, may result in corrosion of metals, particularly in conjunction with water condensation, and subsequent dilution. Corrosion of galvanized metals can result in zinc toxicity.

Total energy intake can also be a problem with liquid feeds. Molasses is a good source of energy (about 88% of the energy value of barley); however, most liquid feeds contain only 50% to 70% molasses. This lower energy restricts urea use, particularly in high roughage situations, and leads to poor animal performance. In supplement schedules that call for 2 to 3 pounds (0.9 – 1.4 kg) of barley, it would require 3 to 7 pounds (1.4 – 3.0 kg) of liquid supplement to be isocaloric. In general, when a supplement exceeds 3 pounds, roughage intake is reduced. Also, liquid supplements become very expensive at these levels. Fats, both animal and vegetable, and alcohols, both ethyl and propylene glycol, have been added to liquid supplements as a way to increase energy in liquid supplements. The price of these additions is often prohibitive to wide scale use.

Properly used with the right class of animals, liquid supplements can be as effective as any other supplement type as long as needed nutrients are provided. Some managerial and nutritional problems must be worked out, particularly continual availability of forage, regular feeding, intake control, and energy level, before their optimum value is reached. Liquid supplements are not always the best buy in terms of nutrients or cost and any supplement containing urea should be used with caution.

Blocks of various types offer many of the same advantages and disadvantages as liquid feeds. Blocks can serve as a vehicle for nonprotein nitrogen, medicaments, antibiotics, vitamins, minerals and other feed additives in addition to masking undesirable flavors, cutting waste, reducing dust, and providing a certain amount of convenience. As with other supplementation methods, with the exception of hand feeding, controlling intake, both on a group basis and between individual animals, is the biggest problem with blocks. Intake control measures in blocks are primarily through the ingredients and/or the physical characteristics of the block. As with liquid feeds, results from range studies using blocks have not been encouraging.[33] Blocks can be an effective supplement method when properly produced and used. However, as with all the other free choice supplement methods, intake is still a major problem and more work needs to be done on this.

Daily hand feeding of supplements is still the preferred method, where possible. Daily gains have always been reduced with any of the convenience supplement schemes. However, this does not fit into all management schemes or situations. Cost, ease of handling, mixing, and feeding facilities all have to be considered along with the manager's abilities. Mechanics and supplementation cost have to be determined in each individual situation. Salt control, blocks, liquids, pellets, etc., all offer viable alternatives to hand feeding in specific instances.

The relative advantages of each kind of supplement need to be evaluated to determine where it fits into the livestock program. Final costs of production are more important than out-of-pocket costs. Consider the feeds available and the nutrients required by the animals and compare the available supplements that will supply the proper nutrients at the best price. The cheapest supplement may not be the most profitable to feed in terms of animal performance per unit of cost. Safety, nutrient adequacy, and management must be considered along with cost before the decision is made to feed one type or another.

OPTIONS BEYOND ECONOMICAL SUPPLEMENT LEVELS

Data indicate that because of decreasing forage quality it is impractical to supplement for economic production of market animals beyond the middle of August under the range conditions at Squaw Butte. Beyond this point an increased supplement level inhibits forage intake and a substituting of expensive concentrates for relatively cheaper forage occurs.

Sell Market Animals or Move to Better Feed

By removal of salable yearlings from range early, the remaining feed can be used for maintenance of the breeding herd. Along with early weaning, which will be discussed in the next section, additional condition can be put on the cows before the winter.

A viable option is to put yearlings on better feed. This may be meadow aftermath from the haying operation on irrigated meadows, rake-bunched hay, irrigated pastures, higher elevation ranges, etc. However, when cattle are moved to a new feed source it takes a 2 to 4 week adjustment period before efficient gains are realized. Thus, it is important that the feeding period prior to sale of these animals is long enough to warrant moving them as opposed to early sale off range.

Time of Weaning

Traditionally, calves in the Great Basin region have been weaned at about 7 months of age, during late October or the first part of November. However, as shown in previous figures, gains of these calves are very poor by late August. By removing these calves early, they can be put on better feed with the cows remaining on range. Dry cows do well on range feed during the fall and without the suckling calf will come into the winter in better condition. The condition of cows coming into the winter is important, as the total nutrients required to get the cow through the winter and bred back in the spring are reduced as condition going into the winter is increased.

Figure 10 presents some early weaning data from the Squaw Butte herd. Early-weaned calves were removed from their dams on September 12 and put on meadow aftermath and regrowth plus supplemented with 2 pounds (0.9 kg) of barley and 1 pound (0.5 kg) of cottonseed meal. Late-weaned calves remained on range with their dams until October 12 and then were managed with the early-weaned calves. On November 12 all calves were fed meadow hay and received 2 pounds (0.9 kg) of barley and 1 pound (0.5 kg) of cottonseed meal throughout the winter.

Early-weaned calves outgained late-weaned calves by 20 pounds (9 kg) from September 12 to October 12, despite going through the stress of weaning and adjusting to new feed. During the next period of time, from October 12 to November 12, the early-weaned calves outgained late-weaned calves by 31 pounds (14 kg) and were now 51 pounds (23 kg) heavier. Late-weaned calves compensated somewhat over the remainder of the winter, but were still 24 pounds (11 kg) lighter on April 12.[20]

These results would likely favor early-weaning more if calves were weaned somewhat earlier for the early-weaned group and closer to the traditional mid-November date for the late-weaned calves. The advantage of early weaning depends on the quality and expense of feed available for the early-weaned calves and the options available for the late-weaned calf, such as moving the cow-calf pair to higher elevation range or to better feed, such as irrigated pasture or rake-bunched hay. In many cases early weaning does provide a management tool for increasing productive efficiency off rangelands.

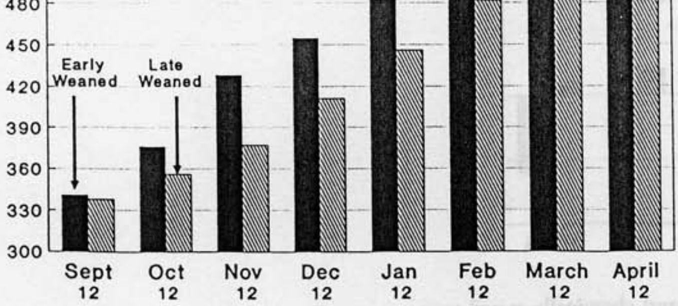

Figure 10. Influence of weaning date on calf weight.

Chemical Curing of Range Forages

Manipulating the forage chemically presents another option for combating poor quality as plants mature. An example of this potential for providing higher quality late-season forage entails growth arrestation of plants while they are high in nutritive value, through application of paraquat (1,1'-dimethyl-4, 4' bipyridinium ion), a bipyridylium herbicide. Crested wheatgrass was treated in mid to late June when the plants were in early anthesis. The chemical was foliar applied at various rates and concentrations with ×77 surfactant employed.[29] A description of treatments and ramifications with various grasses, weather conditions, concentration levels, mode of action, residues, and other information has been reported.[28]

As shown in Figure 11, late-season daily gains of yearlings are increased by over 0.5 pound (0.2 kg) per head per day on chemically cured forage. Chemically cured forage retained higher levels of phosphorus, potassium, lignin, ash, and protein (Fig. 12) and reduced levels of calcium and ether extract, with cellulose being similar. The values in Figure 12 represent change in forage quality due to both maturity and selective grazing. The relative decline of phosphorus between naturally and chemically cured forage closely followed that of protein.[29] Forage intake was increased by about 1 pound (0.5 kg) per head per day on treated forage. The increased quality of forages not only improves daily gains and allows growing animals to be grazed later into the season but also represents a substantial savings in the amount of supplementation needed and improves the efficiency of supplements provided. The addition of 1 pound (0.5 kg) of supplement (barley and cottonseed meal) provided an additional gain of 0.4 pounds (0.2 kg) per head per day.

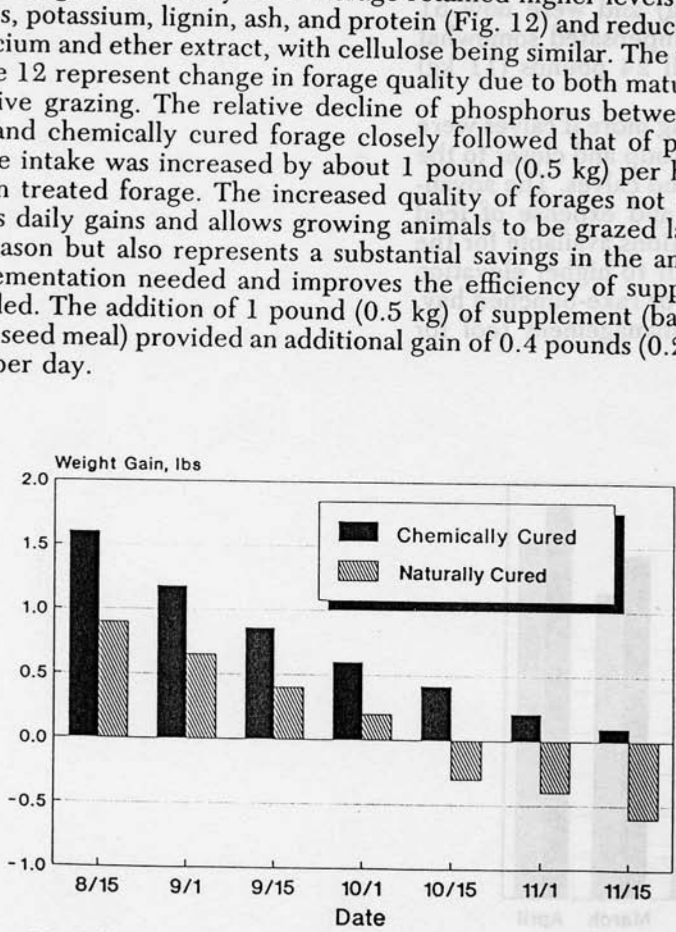

Figure 11. Daily weight gain of yearlings on naturally and chemically cured range forage.

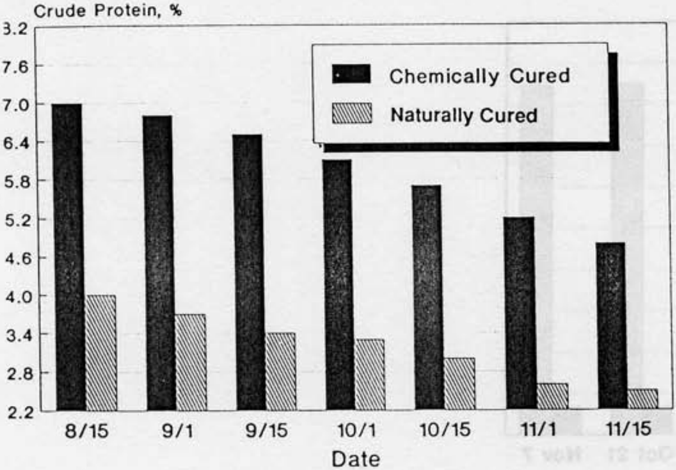

Figure 12. Percent of crude protein content of naturally and chemically cured range forage.

Chemically cured forage appears to have a great deal of potential on perennial grass stands on rangelands. The question with chemicals is whether the potential market is great enough for companies to produce them for this purpose and whether they can be cleared for this use. Paraquat is cleared for other uses in the United States and use on grasses in other countries. Paraquat was used as an example here and, of course, other materials may provide similar results.

Producing Slaughter Animals on Range

Following the supplement schedule described earlier, steers in mid-August are carrying a great deal of condition. It was postulated that by leaving these cattle on range and gradually increasing the concentrate level to a full feed, using the range as a roughage source, steers could be brought to a suitable slaughter grade in about 90 days. There are many alternatives that can be employed. The relationships involved in beef production and marketing need to be considered. Production and growth rate need to be considered from birth through the entire growing phase, with feed requirements, efficiency, and economics all being accounted for in reaching an acceptable goal for slaughtering these steers by mid-November. Beyond this time, requirements accelerate considerably due to cold weather, and animals probably should be removed from range prior to that time. Management considerations to provide for continuous growth need to be employed from birth to slaughter to insure that these animals reach an acceptable slaughter weight.

A typical supplement schedule to bring steers to full feed is presented in Figure 13. The level of concentrate was increased daily as long as the feed was cleaned up each day and held constant or de-

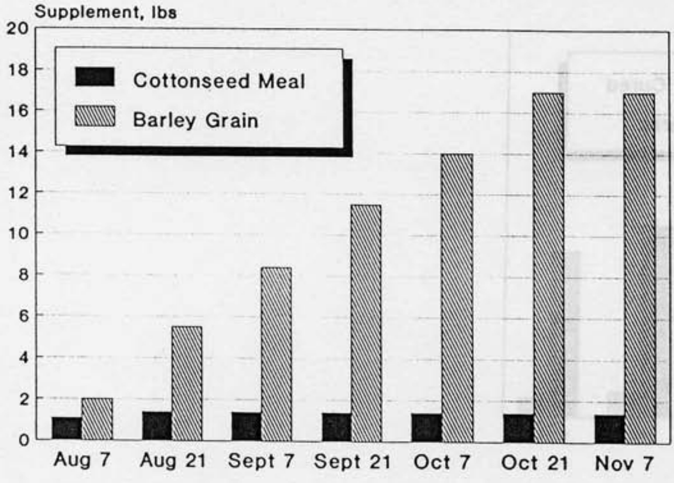

Figure 13. Daily supplement intake of yearling steers during the finishing period.

creased if feed was left. When concentrate levels reached 8 pounds (3.6 kg), the ration was fed twice daily. When full feed, approximately 1.75% of body weight, was reached in mid to late September, feed was presented free choice.

This range regimen (Treatment 1) is compared to four other treatments in Figure 14. Treatment 2 represents feedlot steers to mid November; treatment 3, range to mid-November and then feedlot to early January; treatment 4, feedlot to early January; and treatment 5, irrigated pasture to mid-September then feedlot to early January. All animals were on the prescribed supplement schedule to mid-August.

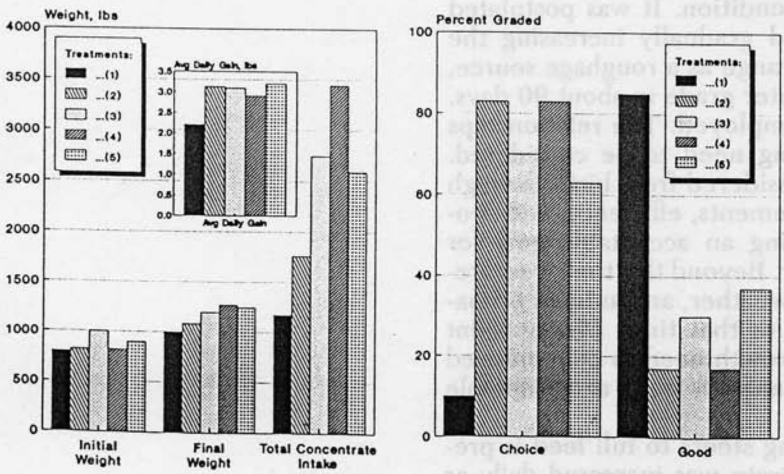

Figure 14. Weight gain, feed, and carcass data during the finishing period.

Steers slaughtered off range weighed less, gained less, and graded lower than steers on the various feedlot systems. However, their total concentrate intake was 34% to 76% of that of the feedlot steers and returned more per dollar invested in feed. Adding yardage, interest on investment, equipment, and environmental preservation costs give the range-fattened steers an advantageous position. Detailed data on treatments, feeding regimens, carcass, and economic evaluation have been reported.[32] Economic evaluations are valid only for a given market and need to be calculated for the price structure or time-frame that exists.

Some consumer preference studies have shown the consumer would buy more of the USDA good grade if it were available.[10] Taste panel work in these trials was somewhat inconclusive. However, these trials and others show that although taste panels detect differences between forage, forage plus limited grain, and feedlot beef, differences were small and all were rated in the favorable zone of the hedonic scale. It has also been concluded that it is important to feed British breeds to slaughter weights of 1,000 to 1,050 pounds (454–476 kg) on limited feed to insure scoring in the acceptable zone.[27]

There are many other alternative systems and management schemes of producing slaughter cattle, including use of irrigated pasture or improved pastures in conjunction with the range feed. A short feeding period at the end of a fairly high grain supplement while still on pasture may be desirable to change color and taste of fat and still provide a substantial savings of grain.

One of the most exciting possibilities in terms of producing an acceptable carcass with a small amount of grain is by using the chemical curing of grasses for late-season grazing as previously described. Acceptable carcasses from range could be produced with as little as 10% of the grain intake of normal feedlot regimens.[32] Many other alternatives, including incorporating straw and other waste products into the systems, calving in the fall and finishing these calves on range, various winter feeding regimens, and different rations have been studied.[10,12,20,24,36]

There are a number of inherent advantages to fattening steers on range or pastures. Because of the low density of cattle in comparison to feedlots, range feeding, in many situations, does not contribute to water and air pollution problems. Less confined conditions also provide for drier, healthier feeding conditions and eliminate the need for manure removal. Range feeding also has less expense in permanent feedbunks and handling equipment. Hauling expense, overhead costs of middlemen and selling expenses may also be less because of retained ownership and keeping the cattle at the same location.

Other factors need to be considered before range finishing can become a large scale industry. One is carrying capacity of available ranges. The previously reported study was conducted on crested wheatgrass ranges with a carrying capacity of about 2.5 acres (1 ha) per animal unit month (AUM). On ranges with a carrying capacity of more than 5 acres (2 ha) per AUM, the distance cattle have to travel for feed could have an adverse effect on rate of gain. Average carrying capacity of semiarid ranges is about 10 acres (4 ha) per AUM. Thus, opportunities are somewhat limited.

Another consideration is that these ranges are, in general, best suited for cow-calf production. It seems unlikely that production of slaughter animals off range would, or should, increase to the extent that it would adversely affect the number of brood cows that can be carried. Also, limited supplies of grain are produced in these arid regions. Slaughter beef production should probably be limited to higher quality ranges and areas in which grains are readily available.

The possibility that production of slaughter grade cattle from range or grass will replace production from the feedlot is remote. On the contrary, it provides another marketing channel for cattle producers and another choice of meat for consumers. We will undoubtedly always produce feedlot beef in this country. A market will probably always exist for highly finished beef for certain clientele, such as restaurants, hotels, and caterers and for a portion of the population that simply prefers beef with a high degree of finish. However, a tremendous market also exists for those who want a leaner cut of beef, prefer the taste of short fed animals, or would like to buy a cheaper grade of beef. Consumption of imported beef is an indication of preference for this type of product, and we should be competing stronger for a share of this market. One reason these countries can undersell us is that they depend heavily on forages rather than more expensive concentrates for production. However, low land and labor costs also are considerations.

Data suggest that range or pasture supplemented steers can be adequately finished by any one of several systems, depending on many factors including a market for the grade of cattle produced. The overall beef system used ultimately responds to the market place and to profitability.

Time of Calving

Time of breeding and subsequent calving is another management tool for getting optimum production out of a given forage situation. Again, it is important to inventory the forage resource with respect to quality and relate this to nutritional needs of the animals on a year-round basis. Availability of outside feed sources such as hay, grain, irrigated pasture, etc., also need to be considered, along with management preferences and capabilities.

On most desert range operations, parturition occurs during March and April. Problems encountered at this time include poor calving weather, long breeding seasons, and light weaning weights. Problems such as infectious diarrheal and respiratory diseases are compounded by calving on wet muddy flood meadows during the spring before cattle are allowed on the range. Wind is also prevalent at this time of year, and wind-chill can adversely affect calf morbidity and mortality.

By calving during the fall (October and November), a calf is produced that is big enough to efficiently use the early high-quality forage available in the spring; with the cow still producing some milk, make rapid gains during this period. This program allows calves to stay on the cow longer and continue to make economical gains. Spring-born calves are not big enough during late April to mid June to effectively take advantage of the high quality forage. By the time they are mature enough to use range feed, quality has declined substantially in both protein and energy content. The spring-born calf cannot get much from the forage at this time and the cow's milk production has declined due to the decreased forage quality. Fall calving, while increasing the cost of wintering the lactating cow versus a dry cow, provides a bigger calf to use high quality range feed and increased weaning weights. Wintering cows and creep feeding calves will be dealt with in a subsequent section on winter feeding.

Weaning weights of fall-born calves at Squaw Butte have exceeded that of spring-born calves by 150 to 200 pounds (68–91 kg), with over 1,100 calves over 5 years included in the data (Fig. 15). Most of the fall-born calves were creep fed 20–100 pounds (9–45 kg) of feed. Due to confinement on winter feed grounds, creep feeding of the fall-born calf is more practical than on ranges with spring-born calves. Most of the weight advantage is due to higher gains early in the spring on range, creep feeding, and the additional length of time on the cow. Weaning the spring-born calves later does not appreciably increase their weaning weight, since little gain is made by these calves beyond the first of September, under the existing forage conditions.[18,35]

Conception rates and weaning percentages were also slightly higher in fall-born cows ($P > .05$). Conception rates and weaning percentages represent all cows exposed to breeding. Cows that were

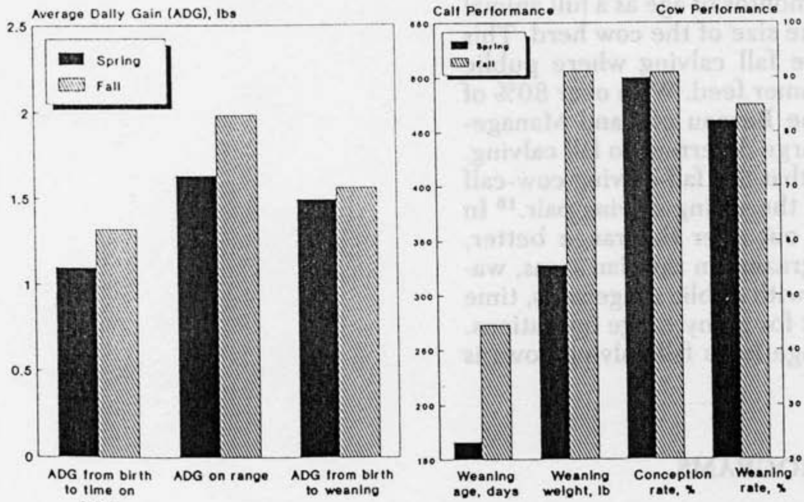

Figure 15. Performance data of spring- and fall-born calves and cows averaged over 5 years.

culled because of pregnancy test results, advanced age, cancer eye, or other reasons prior to weaning were tabulated as not weaning a calf.

Winter management of these fall-calving cow-calf pairs is more conducive for intensive management and nutrition practices to improve efficiency of both production and reproduction. Clinical cases of calfhood diseases, such as scours, and respiratory problems are minimal in fall-born calves, requiring treatment of less than 1%, whereas 10% required treatment in the spring-born calves. Weather conditions are favorable and meadows are bare and dry during October and early November. This same morbidity rate occurred at weaning time with spring-born calves that required considerably more treatment. With cows congregated on hay meadows, the identification and treatment of problems and diseases are also facilitated with the fall calving.

Concentration of the fall-calving cows on winter feedgrounds also facilitates breeding programs. Artificial insemination programs are much easier to accommodate and, with natural breeding, fewer bulls are needed. The advantages of confinement breeding have proved to be beneficial in shortening the breeding season and the calving interval. The data from Squaw Butte do not indicate much of an advantage in conception rates over a 60-day breeding season. However, compared to most range operations, the station cows are on relatively small range pastures, not exceeding 2000 acres (810 ha), and stockwater is hauled, which means animals are more concentrated. The difference in conception and weaning rates would likely be much higher in favor of fall calving on most range operations.

Fall calving offers many advantages, particularly on desert range operations where higher elevation ranges or improved feed resources are not available for cow-calf pairs in late summer and fall. However, a major deterrent to fall calving is the policy of public agencies in charge of public grazing of counting a calf over 6 months of age as a full animal unit on rangelands. This in effect halves the size of the cow herd. This makes it nearly impossible to incorporate fall calving where public rangelands represent a majority of the summer feed. With over 80% of the desert rangelands administered by the Bureau of Land Management or Forest Service, this represents a large deterrent to fall calving. These policies exist despite data showing that the fall-calving cow-calf pair consumes only 25% more forage than the spring-calving pair.[16] In addition, the older calf and cow spread out over the range better, improving distribution and reducing overgrazing in riparian areas, waterholes, meadows, etc. Despite problems with public rangelands, time of calving does provide viable alternatives for many range operations. Producing slaughter grade animals off range from fall-calving cows is discussed in other publications.[9,32]

WINTER FEEDING PROGRAMS

Winter nutritional needs are dependent on managerial goals and subsequent range grazing programs throughout the following grazing season. Winter supplementation programs are simpler and more easily adopted. Harvested hay provides a nutritionally constant feed source and therefore a stable supplement that does not change over time. Also, cattle are in more confined areas, making supplementation easier.

The following discussion will assume hay is being harvested at the proper time, which provides hay with crude protein ranging from 7% to 9%. Date of harvest or maturity of plants at harvest probably contributes more to quality of hay than any other single factor. The earlier hay is harvested the more available nutrients are for production. However, due to spring flooding conditions in many areas, meadows can seldom be cut prior to late June or early July. These dates happen to correspond to near maximal levels of protein and dry matter production on the meadows. Protein and energy content of meadow hay harvested at various dates and digestibility of various nutrients are presented in Figure 16.[21]

Growing Animals

Much of the roughage used for wintering calves and yearlings in most of the west is native meadow hay. Factors contributing to its low quality for growing animals are relatively low levels of crude protein, low digestibility, and high crude fiber values. Young animals simply cannot consume adequate quantities for acceptable performance. Weaner calves on hay alone do little more than maintain themselves and, in some cases, may lose weight.

Many studies reporting the effect of winter gain on summer gains have been conducted with the idea of obtaining inexpensive gains on grass and selling long yearlings as feeders in the fall. High rates of winter gain together with the increased number of days on feed have a

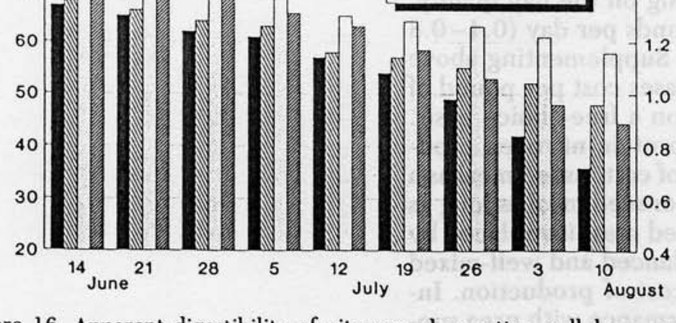

Figure 16. Apparent digestibility of nitrogen, dry matter, cellulose, and nitrogen content of hay harvested at different dates.

significant negative effect on subsequent summer gain. However, calves restricted to limited winter gains for long time periods (100 days or longer) are considerably lighter at the end of the summer grazing period. In short-grass years when growing stock must be sold in the spring to maintain the cow herd, there is a considerable economic loss from the restricted winter feeding program. Total digestible nutrients required during the winter per pound of gain accumulated during both the winter and summer periods reach a minimum when animals gain 1.2 pounds (0.5 kg) per day during the winter, with the greatest return over feed costs occurring at about 1.6 pounds (0.7 kg).[2] Steers should be fed to gain 1.5 to 1.8 pounds (0.7–0.8 kg) per day when feed cost-cattle price relationships appear favorable and 1.0 to 1.4 pounds (0.5–0.6 kg) per day under less favorable conditions. Calves can gain up to 1.6 pounds (0.7 kg) per day in the winter without substantially affecting summer gain as long as the animals are supplemented during the summer to gain at a maximum rate. Without supplementation, the summer gains are drastically reduced with increased winter gain levels. The size of the calf entering the winter period also affects the economics of the optimum winter gain. Other management goals, such as producing range-slaughter animals and target weights for optimum development of replacement heifers also need to be considered for determining desired winter gains.

Supplemental protein and energy must be fed along with native meadow hay to provide economical gains for wintering weaner calves and yearling cattle. Protein is critical here or in any feeding regimen because if protein is deficient and microbial protein needs are not met, then microbial numbers are decreased, digestion of forage is reduced, rate of passage is slowed, and consequently intake is reduced. Energy and other nutrients are shorted as well, due to reduced dry matter intake. A combined supplement of 1 pound (0.5 kg) of cottonseed meal plus 2 pounds (0.9 kg) of barley, or their equivalent, with a full feed of good meadow hay provides a well-balanced growing ration for weaner calves. Figure 17 represents a typical gain response and cost per pound of gain with and without supplements. Feed values used were $50, $100, $200/ton for hay, barley, and cottonseed meal, respectively. Supplements were fed on a daily basis. Gains on hay alone have varied from 0 to 0.6 pounds (0.3 kg) per day, depending on the hay quality. Supplemented calves have gained 0.9 to 1.7 pounds per day (0.4–0.8 kg) depending on the quality of hay and calves. Supplementing above this level will reduce hay intake and often increases cost per pound of gain. A phosphorus source should be available on a free-choice basis.

Under carefully controlled conditions, nonprotein nitrogen products such as urea and biuret can be used in place of cottonseed meal as a protein source. Gains will approach those of cottonseed meal as long as the energy lost from the removal of the cottonseed meal is replaced by barley or another energy feed. In a properly balanced and well-mixed ration, urea can increase efficiency and lower cost of production. Increased frequency of feeding will increase performance with urea supplement. However, under less controlled conditions, palatability and

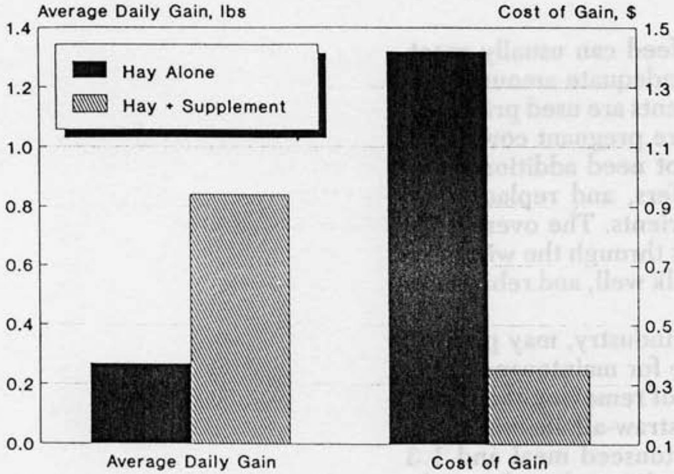

Figure 17. Winter daily weight gain and cost of weight gain for weaner calves with and without supplement.

toxicity problems can arise when urea is fed. Results from urea with low energy, high roughage, or limited feeding programs can be disappointing. Biuret is more palatable and acceptable to the animal and is less toxic, making it a more desirable source of nitrogen under these circumstances. Increased efficiency can often be realized by supplying the supplemental nitrogen with both a natural and nonprotein source.[23]

Condensing meadow hay bulk through different processing methods offers some opportunity for greater consumption and, consequently, an improvement in calf performance. Chopping or wafering hay does not seem to offer much improvement. Pelleted hay can increase intake by 25% or more and roughly double gains over long hay.[19,39] The main disadvantage of processed hays is added costs of grinding and pelleting, along with transportation costs to and from the feed mill, or the cost of equipment to do it in place. Supplements, in most cases, are probably a cheaper way of improving performance.

High quality alfalfa hay alone often will provide adequate winter gains on growing animals. Average to poor quality alfalfa does require an energy supplement. Poor to average quality alfalfa hay does not provide more energy than average quality meadow hay. Whereas chopping did not improve performance with meadow hay, calves on chopped alfalfa consumed more and gained considerably more than those on long hay.[19]

Alfalfa also can be used effectively as a protein supplement for meadow hay. Two to three pounds of alfalfa will provide as much protein as a pound of cottonseed meal and, when fed with an energy level similar to the standard supplement, will give similar gain responses.

Mature Cows

Older animals with the capacity for more feed can usually meet their requirements from meadow hay provided adequate amounts are available. In many livestock operations, supplements are used primarily in the winter for maintenance.. In general, mature pregnant cows on a full feed of meadow hay or limited alfalfa do not need additional nutrients. However, lactating cows, first-calf heifers, and replacement heifers do, on occasion, need supplemental nutrients. The overall objective of most wintering programs is to get cows through the winter as economically as possible in condition to calve, milk well, and rebreed in the spring.

Grass straw, a by-product of the grass seed industry, may provide beef producers with a cheap source of roughage for maintenance purposes and help grass producers recover the cost of removing the straw. Cows have been successfully wintered on grass-straw-alfalfa mixes and on grass straw plus 0.7 pounds (0.3 kg) of cottonseed meal and 1.3 pounds (0.6 kg) of grain. Depending on straw quality and cattle condition going into the winter, ratios of 4 : 1 to 1 : 1 of grass straw to alfalfa will adequately maintain pregnant cows. Lactating cows require about a 1 : 2 ratio.

Harvesting and feeding hay is the most expensive practice of a range cattle operation. It costs approximately $30 per ton to produce hay and feed it out. Wintering cows on rake-bunched hay has proved to be a viable alternative. With this system, hay is cut, then raked into small piles, 80 to 120 pounds (35 to 54 kg), and left in the field. Cows are then strip grazed, by using New Zealand type electric fences, throughout the winter. Figure 18 shows the weight gain change of these cattle as compared to traditionally hand-fed cows on harvested feed. Cows grazing rake-bunched hay came out of the winter in better condition than controls and did not receive any supplements or supplemental hay. Conception rates, calving interval, weaning weights, and attrition rates have been equal between control and treatment groups.[31]

Cattle have been wintered on rake-bunched hay now for 10 years and in only 1 year was emergency hay fed. In that year, the bunches were smaller and the high ground was grazed first, leaving the low areas where snow was as deep as 3 feet and a very unusual ice rain put a layer of ice on top of this, making it impossible for cows to find the hay. With higher, more compact bunches being used now and using low ground early, this can be avoided.

The rake bunches appear to emit heat, possibly due to fermentation, and to some extent tend to remain reasonably open, or at least visible, through the snow. They discolor and are not attractive, but have a sweet smell similar to haylage. During the one year when supplemental hay was required, cows would leave the feed ground early and search for rake-bunches, showing a definite preference for them. Bunches have been successfully grazed through long periods of 24-inch snow cover and under 12 inches of water toward spring.

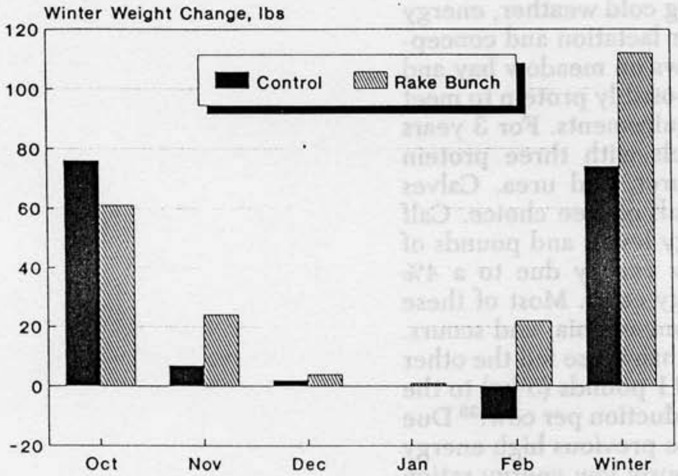

Figure 18. Winter weight change of cows on baled (control) or rake-bunched hay.

Weekly fence movements seem to be near optimum, creating very little waste, in fact less than with traditional feeding.

One of the keys to the increased performance of cows on rake-bunched hay and reductions of waste occurs in the spring when the weather warms and the meadows become wet and muddy. Cows on the rake-bunched hay continue to graze aggressively through this period, whereas the traditionally fed cattle tended to brawl and follow the feed wagon, tramping hay into the ground. They would then leave the feed ground and attempt to graze emerging spring grasses.

The cost of wintering cattle on rake-bunched hay has been $30 to $40 less per head than the traditional feeding of harvested hay. The bunches appear to have little effect on subsequent production and composition of forages produced by the native flood meadows.

Feeding the ionophore, monensin, a biologically active compound produced by *Streptomyces cinnamonensis*, has proved effective in either putting additional weight on cows over the winter or keeping the weight constant and reducing hay intake.[37,38] Cows fed a full feed of meadow hay plus 200 mg of monensin had daily gains of 0.2 pounds (0.1 kg) higher than cows fed meadow hay alone.[34] In studies where cow weights were kept equal between control cows receiving meadow hay and cows receiving meadow hay plus monensin, hay savings of up to 13% were realized. This represents another management tool for improving productive efficiency of range cattle operations. Monensin feeding has also partially alleviated the negative reproductive performance of replacement heifers receiving implants.[34] The use of monensin with very low quality forages can seriously affect weight gains and body condition scores in pregnant cattle.

One of the major nutritional concerns of calving in the fall is the nutrient requirements during the winter. During cold weather, energy must be provided for maintenance as well as for lactation and conception. An early assumption was that lactating cows on meadow hay and their calves would need additional energy and possibly protein to meet maintenance, productive, and reproductive requirements. For 3 years cows were supplemented at two energy levels with three protein sources, which included cottonseed meal, biuret, and urea. Calves were creeped at two levels, free choice and half of free choice. Calf gains were similar from cows on the two energy levels and pounds of calf weaned actually favored the cows on low energy due to a 4% higher mortality rate in calves from high energy cows. Most of these calf losses were due to respiratory problems, pneumonia, and scours. Cows fed biuret performed considerably lower than those fed the other protein sources. The higher creep level added 11 pounds (5 kg) to the weaning weight and 19 pounds (9 kg) of calf production per cow.[35] Due to these results, the last 7 years of the study, the previous high energy cow supplement was eliminated and the previously low energy ration was compared to hay alone and compared to free-choice creep feeding to no creep and all the interactions. Biuret was retained as a protein source and compared to cottonseed meal. This provided two energy levels and two protein sources.[35]

The addition of protein alone (biuret) to meadow hay did not improve performance. Cows on hay alone produced 16 pounds (7 kg) more calf per cow. On the high energy level cottonseed meal and biuret cows produced with a slight advantage of 9 pounds (0.4 kg) over those receiving cottonseed meal alone. Figure 19 shows summary data from these trials. When calves were not creep fed, all supplements fed to cows produced a negative response in pounds of calf produced per cow. Supplementation of cows produced negative effects in most cases and would not be feasible. However, creep feeding efficiency was increased when cows were supplemented with additional energy. Throughout these trials there was a slight negative effect on cow production and reproduction when calves were creep fed and cows were not supplemented. The larger calf may exert more aggressive nursing behavior, increasing milk flow and nutrient requirements of the cow.

Creep feeding year around as opposed to either summer or winter was compared to no creep for 1 year. Results show that creeping both winter and on range to be inefficient. Either creep in the winter or summer alone provided more efficient gains. It would be more convenient and feasible to creep on the winter feedgrounds than on summer range. Details of creep feeding results have been reported.[35]

The data indicate feeding good quality meadow hay alone may be the most profitable way to winter fall-calving cows and their calves. During times of high cattle prices in relation to feed costs, it may be profitable to supplement the hay with both protein and energy and to also creep feed the calves. Winter creeping of calves without supplementing cows may also pay when price conditions are favorable. Supplementing cows without creeping the calves did not pay under any conditions in these trials. These results are somewhat surprising; how-

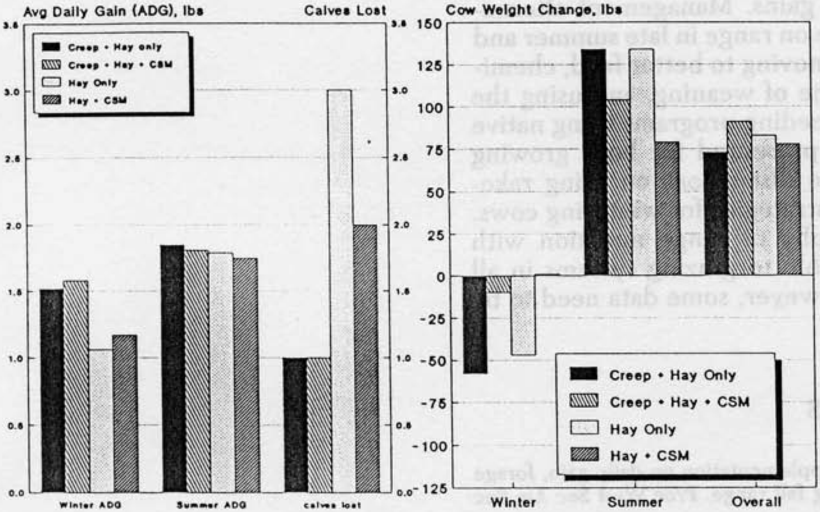

Figure 19. Creep feeding and supplementation influences on calf and cow performance during the winter and subsequent summer feeding period.

ever, some of the treatments may have altered hay intake. These conclusions are valid with good quality meadow hay or better forage, but results would be different with poor quality hay. Heavier milking cows would have higher nutrient requirements and may also change results somewhat.

One other management consideration that may be beneficial for many range operations is early turnout of the mature cows. This requires saving feed on range from the previous growing season for use early in the spring of the next year. The current year's growth on range is not adequate to maintain cattle until early to mid May, so old feed must be used or harvested feed hauled to range to maintain cattle at an adequate level. By turning out March 1 and calving on range, many of the health problems connected with calving on the wet muddy meadows are negated. Cattle can spread out more on range and the brush and juniper provide excellent thermal cover for young calves. This also facilitates the rake-bunch treatment by getting them off the meadows prior to spring flooding.

SUMMARY

A number of nutritional and managerial schemes have been presented to help optimize range livestock production. Forage quality, animal requirements, and the animals' ability to meet their requirements from the forage is presented. After determining the nutritional value of the forages and animal requirements, prescription supplementation produces very efficient additional gains. Management alternatives to compensate for poor quality forage on range in late summer and early fall, such as selling market animals, moving to better feed, chemical curing of forages, time of calving, time of weaning, and using the range as a feedlot are discussed. Winter feeding programs using native flood meadow hay as a base were also presented for both growing animals and mature cows. Included were discussions on using rake-bunched hay, an ionophore, and feeding strategies for wintering cows. Material presented illustrates a philosophy of range nutrition with methods and procedures that are adaptable to grazing systems in all parts of the world. It should be noted, however, some data need to be extrapolated to fit local conditions.

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