Animal Care Series:

BEEF

CARE PRACTICES

Beef and Range Workgroup
University of California ◆ Cooperative Extension

FOREWORD

Beef Care Practices is one of a series of publications addressing the issue of animal care relating to food animal production in California. This publication is the result of a joint effort between the University of California Cooperative Extension, beef industry representatives, and members of the Beef and Range Workgroup.

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INTRODUCTION

An ethically acceptable level of cattle well-being is not limited to one set of husbandry practices. Rather, it may exist over a wide range of conditions provided in a variety of beef production systems.

Science has not produced the answers required to understand all the basic needs of cattle. Continued research is needed to provide additional information. Currently, we must base animal care on past research and decades of practical experience.

This publication was written to assist and foster the understanding of factors affecting the well-being of cattle. Information presented is based on published data, scientific principles, expert opinion and experience with the methods and practices for the safe, humane, and efficient production of beef in California.

The goal of this publication is not to set forth or suggest specific guidelines for production practices but rather explain why, when and how these practices are used in the complex beef production systems found in California. To best describe management practices it is also necessary to describe factors which influence their use. These include an understanding of the regions in the state where cattle are produced, the types of beef production systems, and a basic knowledge of animal science as it relates to beef cattle.

THE BEEF CATTLE INDUSTRY IN CALIFORNIA

Beef production practices in California are influenced by the region where the production occurs and the type of operation involved. Production practices also are influenced by the breed, nutritional requirements, reproductive status, and behavioral characteristics of cattle.

California is the second largest state in the contiguous United States and probably the most geographically diverse. It also contains both the highest and lowest elevations of the contiguous United States. California's climate varies from Del Norte County's cool temperatures and 80 to 100-inch annual precipitation, to Imperial County's 2 to 4-inch rainfall and hot 114°F summer days. This geographic diversity, along with its climatic and environmental conditions, has resulted in the development of a complex livestock production industry.

California has more than 100 million acres of land. Approximately 40 million acres are range and pasture lands. The rangelands of California are classified as Mediterranean, desert, and intermountain. They are among the most productive in the West. The predominant range type is Mediterranean annual rangelands.

They encompass all the Central Valley and the coastal and foothill ranges. Annual range production in these regions is seasonal, but grazing of green or dry forage occurs throughout the year. In comparison, the Mediterranean grasslands of the North Coast are unique because forage production spans a longer growing season because of increased rainfall and moderate climate.

The desert rangelands are located mainly in the southern region of the state. A mixture of annual vegetation, perennial grasses and shrubs is the primary forage supply on the desert range. Winter and spring rains support annual plants and grasses; however, rainfall can be erratic and shrubs supply feed for livestock during dryer periods.

The intermountain ranges are located in the northern and eastern portions of the state. Winter dormancy and spring-summer growth dictate a different livestock management scenario for forage utilization on these rangelands. Cattle may graze the lower elevation forage in the spring and then be moved to higher elevation pasture during the summer. Generally, forage needs to be harvested and stored during the summer for winter feeding. In the fall, cattle may graze crop residue, residual rangeland or pasture forage. Cattle may be fed hay or transported out of the region during the winter.

TYPES OF CATTLE OPERATIONS

An important commodity in California, beef cattle are produced in all but one county. Nationally, the 1991 inventory of cattle and calves in the state ranked fifth among all states. There are four types of beef cattle operations throughout California: cow-calf, seedstock, stocker, and feedlot.

A ***cow-calf*** operation maintains a breeding herd of cows, replacement heifers and bulls. Steer calves and most heifer calves are sold, but some heifers are selected to enter the breeding herd. Calves are sold at weaning or are retained as stockers. Climatic and management conditions dictate different calving seasons in different regions.

Seedstock production is a specialized cow-calf operation sometimes referred to as producing purebred or registered cattle. The goal of seedstock production is to make genetic improvements in cattle that benefit the entire beef industry. Improvements in purebred cattle are documented through the extensive recording systems maintained by both the producer and breed organizations. Seedstock are marketed as herd sires and replacement females to other seedstock producers or to cow-calf producers.

Stocker operations grow steer and/or heifer calves or yearlings on rangeland or other roughages. Generally, the cattle are purchased following weaning in the fall and are wintered on low quality feed until new grass can nutritionally support the animals. The beginning of the grazing season varies with location, rainfall and temperature. Stocker cattle are normally marketed or transported to feedlots at the end of the grazing season when the nutritional quality of the forage starts to decline.

Feedlots use facilities designed to confine large numbers cattle. The feedlots are designed to meet the feed, water and care required of cattle held in confinement.

Beef fed solely roughage feeds could take years to reach market weight. Land resources in the United States are insufficient for a forage-based beef supply at the present level of consumer demand. With the vast amount of feed grains and by-products available in this country, feedlots efficiently feed large numbers of cattle. Higher energy rations greatly reduce the time required to reach market weights. By feeding cattle in feedlots, finished cattle weighing 1,050 to 1,150 pounds can be marketed at 18 to 24 months of age.

BREEDS OF CATTLE

There are 275 recognized cattle breeds in the world. There are more than 40 breeds in California, including the major dairy cattle breeds. Five to 10 breeds dominate beef production. In the case of seedstock and cow-calf producers, breeds may be introduced into herds by artificial insemination.

Breeds differ in many characteristics. Simple observable traits may include hair and skin color or the presence or absence of horns (polled). Differences in production traits such as reproductive performance, growth rate, milk production, disease resistance and carcass merit also occur within breeds as well as between breeds.

Most cattle produced in California are crossbred to combine or match desirable characteristics from two or more breeds. Crossbreeding may be used to develop animals with characteristics for optimum production in a particular region.

Selection of a breed or breeds is based on many factors, including the environment where the production occurs, breed characteristics, labor resources, market demand and personal preference.

NUTRITION

Because of physiological processes unique to ruminants, cattle readily consume and receive adequate nutrition from feedstuffs unsuitable for many other types of animals. The Food and Agricultural Organization of the United Nations estimates that more than 65 percent of the world's land mass cannot be farmed and can only be harvested by ruminant animals. Beef cattle are capable of utilizing numerous by-products produced in the processing of agricultural products for human consumption. Examples include beet pulp from sugar production, citrus pulp after juice extraction, and milling commodities from the production of flour.

Adequate feed quantity and quality are required for body maintenance and growth. However, cattle adapt to periodic over or under availability of feedstuffs. During periods of inadequate nutrition, some body functions may be adversely affected, but with the resumption of an adequate feed intake, normal conditions can be restored.

Required nutrients

Numerous dietary components or elements are essential in the diet of beef cattle. These components include water, energy, nitrogen, minerals and fiber. Bulletins produced by the National Research Council are generally accepted as nutritional guidelines. These are periodically updated and are reliable references.

Minerals required in cattle rations include calcium, phosphorus, cobalt, copper, iodine, iron, magnesium, manganese, molybdenum, potassium, selenium, sodium and chlorine. Other elements have been suggested as essential but little scientific data is currently available for cattle.

Interactions between minerals further complicate requirement levels in cattle diets. Additionally, some minerals should not be fed above certain levels. Federal and state regulations apply to some of these minerals.

Vitamins required by cattle may be supplied in feedstuffs, or may be synthesized in tissues and by microorganisms in the rumen. Vitamins B and K are produced in the rumen soon after solid feed is introduced in the diet. Vitamin D is synthesized when the animals are exposed to sunlight and is also found in sun-cured forages. High quality forages also contain large amounts of vitamin A precursors and vitamin E. Vitamin A is the only vitamin likely to

be of practical importance in the diets of cattle.

There have been numerous attempts to establish objective, numerical standards for normal compounds or chemicals in the body (metabolic profiles) that could be used to evaluate an animal's nutritional status. Many constituents found in the circulatory system have been measured and data published indicating averages and ranges. There is little evidence, however relating this data to an animal's performance or nutritional well-being. For example, different feeding regimes influence protein levels in blood (serum), but changes are subtle and difficult to detect and interpret.

REPRODUCTION

Beef cattle can reproduce throughout the year. They are not seasonal breeders like horses, sheep and goats. This allows producers in different regions to adjust their breeding program to have cows calve at the most favorable time of the year. Frequently forage utilization later in the nursing calf's growth period and climate influence the calving period. Typically, there are fall and spring calving periods, but calving may occur any time. Puberty normally occurs in both bulls and heifers by the time they are 6 to 18 months old. The age of puberty varies greatly due to breed or environmental factors such as climate and level of nutrition.

It is possible for beef cattle to reach sexual maturity and enter the breeding herd as yearlings. Bulls can breed a limited number of heifers or cows as yearlings. Heifers may be successfully bred as yearlings (14 to 16 months of age) to calve for the first time at two years of age.

The gestation period for a cow is slightly more than 9 months. Typically, beef cows are bred to calve every 12 months during their productive lives. Beef cows usually remain in full production for 5 to 8 years or more. Bulls remain in service for 4 to 6 years in commercial breeding herds. Superior animals in purebred herds may stay in production longer, depending on their breeding value.

The birth of a healthy calf is essential for continuation of the production cycle. Failure to produce a live calf can occur any time in the reproductive process. This can be the result of disease, nutrition or genetic factors that affect the ability to conceive, maintain pregnancy or successfully deliver a live healthy calf.

BEHAVIOR

The observation and assessment of behavior patterns in cattle is important in determining health, minimizing stressful or painful situations, assisting in the improvement of production practices, and providing for the well-being of individual animals. Understanding and recognizing cattle behavior is critical in the proper design of livestock facilities, during transportation, and during procedures involving the interaction of handlers and animals.

Senses

The basic senses help cattle perceive their environment or situation and provide information that governs their subsequent reaction. Cattle have nearly a 360^{o} field of vision. This is an important consideration when approaching cattle. Cattle possess relatively poor depth perception; however, they can distinguish between most colors. They easily detect motion and rely on their vision for identifying herd mates or receiving signals provided by different body postures. In cattle, positions and motions of the head and body can indicate alarm, threat or submission.

Cattle can move their ears to improve the acuity of hearing. An unexpected or sudden loud noise may startle animals and this is an important consideration when handling or confining cattle. Information on possible threats or identification of an approaching animal can be communicated between animals by vocalizations and hearing. Smell and taste are significant in determining feed preferences, indicating the reproductive status of females, identifying territory, and bonding between a cow and her calf. Tactile or touching stimulation may convey signals of heat, cold, pressure, or pain that will signal the central nervous system to evoke appropriate physiological and behavior changes. Cattle may change or alter their posture to conserve or avoid heat, while pain can result in the animal fleeing its immediate environment.

Types of behavior

Instinct or innate behaviors have evolved so animals can survive and reproduce given an appropriate environment. Examples of innate behavior include the receptive stance of a female at mating or the initial nursing behavior of a newborn calf.

Behaviors resulting from previous experience are learned behaviors. Learned behavior requires the animal to use its memory and store information over time. Cattle walking to the feed bunk at the sound of a tractor is a learned behavior. A

behavior also can be altered as an animal becomes accustomed to a harmless stimulus, such as a calf showing little or no behavioral response to a noisy tractor. Some behaviors can be changed; others, such as sexual behaviors, are more difficult to alter.

Daily behavior types

Cattle exhibit daily behavior cycles, especially for resting, grazing and ruminating. These daily patterns may be dependent on the light-dark cycle, dietary components, age of animal, temperature and other stimuli. Cattle spend a variable amount of time eating, depending on their diet and its availability. Cattle grazing on pasture spend a large portion of time eating, whereas cattle fed a concentrated diet spend relatively less time eating. Most eating occurs during two periods of the day, just after dawn and before dusk. Cattle spend about 20 episodes each day in a drowsy or sleep state that may total 7 to 8 hours of rest.

There may be an internal motivation for exploration that depends on the animal's age, weight and sex. This involves using their senses along with locomotion skills. Cattle seek to explore changes in the immediate environment and will also closely investigate novel objects.

Grooming is performed by individuals and within groups. Often two animals will engage in mutual grooming. Cattle stand in proximity to each other and switch their tails to counter fly disturbance. They will also alter their lying position to protect sensitive skin areas from flies.

Social grouping and spatial relationships are important management considerations especially in confinement systems. Cattle are social animals. Dominance or the "pecking order" determines the hierarchy within animal herds. Dominance is a learned and predictable relationship between a pair of animals, where one is consistently submissive to the other. In cattle, dominance is probably determined within 24 hours of grouping and may be related to age, sex, weight and breed of the individual animals. Aggressive behaviors are often exhibited following regrouping or the introduction of additional herd members. Regrouping younger animals produces less aggression and fighting than does regrouping older animals. This is particularly true with bulls. Dominance displays become more pronounced when there is limited access to resting areas, feed and water. Dominance order is not permanent and may change depending on the age, health or production status of the herd members.

Production losses can occur if space is not adequate for proper social

spacing of each animal. Many variables influence social space. Included are floor type, water availability, feeder space, pen mates, sickness, pen shape, kinship among pen mates and environmental factors such as fly prevalence, shade availability and temperature.

Cattle possess a natural following tendency. This is especially evident when a herd is threatened or aroused. Following behavior may be dependent on the animal's ability to maintain visual contact with other animals. The flight zone of an animal may determine how close a handler can approach an animal. The flight zone is an area surrounding an individual and moves with the animal. Both following behavior and flight zone are important considerations to minimize stress while handling and moving animals or designing facilities. It is usually less stressful to move cattle in small groups than individually.

STRESS AND PAIN

A major concern to everyone involved in animal production relates to practices or conditions that may result in stress and/or pain to the animal. An animal is stressed if it is required to make abnormal or extreme adjustments in its physiology or behavior to cope with adverse effects of its environment or management. Identifying and minimizing stressful situations in livestock production allows for greater reproductive efficiency, growth, and well-being of the animal as well as economic benefits for the producer and consumer.

Stress from the environmental and management aspects of beef cattle production can be classified into four broad categories: thermal, physical, disease, behavioral. The stress described in one category may also manifest itself by creating additional stress in another form.

Thermal Stress

Factors include temperature (heat or cold), humidity, wind, and solar radiation. Cold stress can affect younger or sick animals more severely than mature, healthy cattle. Heat stress can affect lactating and heavier feedlot cattle more than lighter, younger cattle. Certain breeds of cattle are more capable than others of acclimating to cold or hot climates.

Physical Stress

The physical component of an animal's environment includes the space available and the surfaces with which the animal comes into contact.

Disease Stress

This stress is that which results from the onset and spread of disease.

Behavioral Stress

This stress includes those factors which affect normal behavior of the animal. Adequate areas should be provided for activities such as feeding, sleeping or lying, and grooming.

There is no practical, reliable method other than observation to evaluate stress. Short-term stress can increase heart rate, respiration and blood pressure. Long-term stress may induce changes in immunological response and/or hormonal secretions. Stress may also be quantified by studying behavioral adaptations to a specific stressor. Research suggests some methods may be developed to measure stress, but to date these remain to be verified in field conditions.

While difficult to quantify, there are observable indicators of stress. Cattle can be considered undergoing stress when they show one or more of the following signs:

- Lack of appetite
- Abnormal posture
- Restlessness
- Elevated respiration rate
- Lameness or alteration of gait
- Dull or depressed attitude
- Grunting or other unusual vocalizations
- Lack of grooming
- Self isolation from the herd or pen mates.

Pain and stress are different. Perceived pain by an animal is initiated by stimuli transmitting information to the central nervous system via receptors located in the skin, muscles, viscera, or joints. The animal then responds by physiological and behavioral changes similar to those exhibited during stressful situations. However, pain symptoms are often more acute or have a sudden onset.

There are practices used in beef production (e.g., vaccination, branding, dehorning, castration) which can be short term stressors and may also be painful. Other management practices such as gathering cattle to move to new pastures, separating calves from their dams during processing or weaning, and the sorting by age and or sex may also cause short-term stress. Some tools, such as restraints used to perform production practices, create short-term stress but provide a safer environment for both the cattle and livestock personnel.

Although they cause stress over a short period, these practices are beneficial stressors. They provide long-term health and management benefits to individual animals and their herd or pen mates by alleviating long-term stress from injury, disease or nutritional factors. In their management plan, beef producers must consider how to manage stress using practices that may be short-term stressors to improve the long-term well-being of their animals.

CARE AND MANAGEMENT PRACTICES

Feeding Practices

On rangeland, cattle consume a varied diet that may include grasses, legumes, forbs, and brush (browse). Often range situations appear to provide insufficient feed or variable feed quality for cattle. Height of forage alone is not a good indicator of forage quality and the nutritional status of grazing cattle. As plants mature, their nutritional quality for the grazing animal decreases. However, as forage quantity increases the total nutrients available to the animal may increase. Recognition of the possible varied diet of the grazing animal and consideration of the evaluation methods previously discussed will guide the trained observer in assessing nutritional adequacy of beef cattle on range.

Producers should strive to reduce periods of inadequate nutrition through either supplementation or moving the cattle to another location where feed is available. However, cattle can cope with temporary periods of undernutrition. Without intervention by man, beef cattle and wild ruminant animals undergo periods of poor nutrition and body condition. Younger cattle are more susceptible than older cattle to inadequate feed. During periods when feed may be inadequate, efforts to provide adequate nutrition should focus on the needs of younger cattle. Such periods can occur during drought, extreme snowfall, flooding or in other situations beyond human control.

Body condition and the ability to mobilize reserves for periods of inadequate nutrition should be assessed. Body condition affects certain body functions. The ability to sustain such functions as growth and reproduction can be related to the animal's well-being. Attainment of specific body reserves or condition could be used as a guideline to animal nutritional well-being and potential for life cycle activities. Scoring systems have been developed to estimate body condition.

Regular feed intake enhances body functions such as lactation, but cattle can withstand some irregularity in feeding frequency without long-term harm. Water of suitable quantity and quality should always be available to cattle. During hot or extremely cold weather when the possibility of water shortage exits, the water supply should be checked and be available at least once and preferably twice daily. Time necessary for drinking will vary with the number of animals and the

accessibility of water. Water requirements depend on type of feed consumed, temperature, humidity and stage and type of production. Guidelines are available but should be used with considerable judgment since water requirements may range from 4 to 45 gallons per day per animal.

Supplemental feeds can increase nutrition when nutrient deficiencies exist in range forage. Numerous supplemental feeding methods use various products and management strategies. At times, feeding a minimal amount of concentrated protein, energy, and/or mineral supplements may correct nutrient deficiencies in the forage. In other situations, hay may be fed to meet the animal's needs.

Feed and water should be provided in a manner that promotes cleanliness and minimizes health problems. Anticipation and the prevention of adverse feeding conditions from manure contamination, spoiled feed, mud or dust that could compromise the health of the animal is needed when providing supplemental feed.

Occasionally a calf may need supplementation because it is orphaned or is not receiving enough milk from its dam. This supplementation will differ from that of an adult animal because the calf's rumen is much less developed. A young calf cannot utilize roughages or other dry feeds fed to more mature cattle. Liquid milk replacers can be fed to meet the nutrient requirements of a calf. If the calf is a newborn, care should be given to assure it has received colostrum during the first hours after birth.

In California, calves or stocker cattle typically remain on rangelands or pastures until they weigh 600 to 700 pounds. As feeders they enter feedlots for 120 to 150 days to reach a market weight of 1,150 to 1,250 pounds. Feedlots in the desert regions of the state can receive cattle weighing 300 to 450 pounds. These animals which are fed for 240 to 270 days to reach a market weight of 1,050 pounds.

In California feedlots, cattle are fed high energy diets of feed grains and by-products. High energy feeds increase daily weight gains and feed efficiency, reducing the number of days cattle require to reach market weight.

Unlike the range or pasture situation where forage changes in quality and quantity over time, the nutrient intake of animals in feedlots is controlled and nutritional stress is minimized. Feedlot managers should have a quality assurance program to ensure that feeds used in their rations are of adequate feeding quality. The supplier of these feeds should also have a quality assurance program to satisfy

the needs of the feedlot for residue-free feedstuffs which meet the Food and Drug Administration (FDA), Environmental Protection Agency (EPA), and state regulations regarding pesticide tolerance in animal feeds. The program should also include a method that records feed quality being used by the feedlot. It should also maintain records of all feed additives used by the feedlot. These records should be kept for at least three months after the cattle are sent to slaughter.

By-product feeds

California's vast and varied agricultural production system produces large quantities of agricultural by-products. These by-products, often from the processing of human foodstuffs, pose problems in disposal, may contribute to higher prices for the primary product and are often unwanted. However, many of these by-products can provide nutrients needed by beef cattle. Numerous regulations ensure the safe use of agricultural by-products as feed for cattle.

Feed additives

Feed additives for the livestock feeding industry have been used in the United States for more than 30 years. Antibiotics may be fed to provide therapeutic and subtherapeutic protection from disease. These feed additives aid in reducing digestive disturbances that may result from feeding high energy feeds to cattle. The subtherapeutic levels of antibiotics used in cattle feed can increase weight gain and biological efficiency of the animal. The FDA regulates both the type and amount of antibiotics fed to cattle. Research indicates that when antibiotics are used in concurrence with FDA standards, they are not found in beef products.

Ionophores are another class of feed additives used primarily in feedlots. Since ionophores are not absorbed by the animal but act within the rumen to enhance digestion, residues from these products are not found in the carcass. When fed, ionophores are used in very minute amounts, only grams per ton of feed. As with all feed additives, the use of ionophores in cattle feed is regulated by the FDA.

Animal Health Practices

As with other living organisms, morbidity and mortality also occurs in cattle. During the production year in California, the mortality for cattle operations ranges from 1-3%.

A combination of factors involving cattle susceptibility, the environment and the presence of a disease agent is necessary for disease to occur. Producers need to manage their animals to reduce or prevent the incidence of disease. If disease should occur, they must consider how to treat the animal.

A herd health program that addresses the prevention and treatment of disease depends on the type of beef cattle operation it is designed to serve. There will be differences between range and confinement programs, cow-calf and stocker operations and possibly regional differences caused by environmental factors.

While there can be differences between types of operations, the health program should be part of the total cattle management program, incorporating facility design and all feeding, reproduction, handling, and transportation practices. Experienced or trained personnel also are important for a successful health program.

Every producer should have a licensed veterinarian help design and implement a herd health program. The veterinarian can also provide product and management options. Many practices used in beef production require experienced or trained personnel. Some procedures require a veterinarian. When processing cattle, only qualified personnel, with knowledge of the procedure to be performed, should be used.

Procedures such as vaccination, castration, dehorning, pregnancy diagnosis, and artificial insemination are normally performed by producers. However, only licensed veterinarians should perform invasive surgery or administer restricted vaccines.

To be effective, pharmaceutical and parasite control products used to prevent or treat disease must be administered according to the label directions. This includes directions for storage of the product, sanitation practices required in its use, and dosage and method of administration. Only personnel experienced or trained in the use of these types of products should administer them to cattle.

To reduce stress from disease, cattle should be checked by experienced personnel for the presence of sick animals. Cattle in confinement should be checked at least daily and cattle in pastures or on rangeland should be observed as often as feasible.

In confinement operations, and when feasible in range operations, sick or injured cattle should be held in separate "sick" or "hospital" pens while receiving treatment. This isolates them from healthy animals and reduces the transmission of disease. It can also reduce stress. When animals are treated, they should be individually identified. If antibiotics are used in the treatment, the type and amount used should be noted for each animal. These records and those described below are integral parts of a quality assurance program to ensure the wholesomeness of beef products.

Only FDA approved drugs at approved dosages can be administered to sick animals. If sick animals do not respond to label usage, any extra-label drug usage must be under the direction of a licensed veterinarian.

Herd health records of vaccination and parasite treatments should be kept on all animals to monitor disease prevention. A record of all antibiotics used should be kept to avoid excessive medication and stress in sick animals.

When an animal is injured or suffering from a degenerative disease or advanced age and is declining in condition or mobility, additional care should be provided. This may include veterinary care, supplemental feed and water, and protection from other cattle and adverse environmental conditions.

When an animal responds to treatment and recovers but cannot return to the breeding herd or the feedlot, it should be culled and sold for slaughter. Slaughter can occur only after the withdrawal time for any medication has been followed.

If the animal does not recover and becomes permanently physically impaired or non-ambulatory, it should be humanely euthanized. There should be no attempt to transport and sell animals in this condition.

Despite all efforts to provide health care to cattle, a small percentage of the herd will die at birth or later from disease, injury, or other causes. When an animal dies from unknown causes, the decision whether to perform a necropsy should be made with advice of a veterinarian. A necropsy may provide information for adjusting the herd health program.

The carcass of a dead animal may present a health risk to other cattle in the herd or pen. It should be disposed of promptly to reduce the spread of disease and odor. The method of disposal may depend on the cause of death - whether the carcass should be buried, burned, or if feasible, be rendered at a licensed rendering facility. State law and local ordinances may define the manner in which dead animals must be disposed.

Reproduction Management Practices

A number of management practices are used to enhance the reproductive success of the cow herd. Proper decisions made before breeding can prevent reproductive failures. Consideration should be given to implementing a preventive health program and supplementing nutrients, if required. Selecting bulls with records of calving ease can reduce calving difficulties.

Managing young replacement animals to ensure adequate growth before and after the first breeding season and pregnancy is also important. They need adequate nutrition to meet the demands of reproduction and lactation while they continue to grow to maturity.

After weaning, calves are usually grouped by age and gender. Young bulls are separated from non-pregnant heifers. This protects the heifers from potential injury from breeding activity and untimely pregnancies. Young bulls are managed separately from older breeding-age bulls to prevent injury to the young bulls. Care also must be taken when introducing new bulls, regardless of age, into holding pens or fields with other bulls. This can disrupt the social order of the bulls, and injuries from fighting or sexual activity may occur.

Knowledge of the process involved in calving is helpful in deciding whether or when assistance should be provided. Clean calving areas that can be observed easily should be available. Depending on the time of year and the region of the state, shelter may be necessary to protect the cow and calf. Under most California conditions, calving can occur in pastures, with the cows seeking their own location to calve.

At calving time, first calf heifers may be managed in groups separate from the main cow herd. This allows for frequent and easier observation in case assistance is needed.

Artificial insemination allows a large number of cows to be bred using the semen from a bull with greater genetic merit than may be available from bulls available for natural breeding. This can improve the genetic quality or diversity of the herd without having to care for a large number of bulls on the ranch.

Embryo transfer is used primarily by seedstock producers. Fertilized ova are non-surgically collected from genetically superior cows and transferred to recipient cows which carry the transferred embryos to term. With either artificial insemination or embryo transfer, herd conception rates

are fairly consistent with those observed in unsynchronized, or natural reproductive cycles.

Rectal palpation is used to determine pregnancy in cows. It is a useful method for evaluating the reproductive efficiency of the herd and possible health problems affecting the reproductive tract.

The reproductive organs of bulls are palpated and semen is collected to evaluate their breeding soundness and fertility.

When the above practices are used, it is important to have appropriate facilities. It also is important that the animals are handled quietly and easily to minimize stress. Only skilled technicians should perform these procedures.

While there is a need to manage for the reproductive success of the breeding animal, there is also a need to inhibit the reproductive process in animals not selected for breeding proposes. Sexually mature stocker and feeder cattle can create stressful situations for themselves and their herdmates in both range and feedlot situations. Depending on the sex of the animal, the following management practices are used to alter reproductive function and prevent stress which could otherwise occur later in the production cycle.

Castration

Sexually mature males are more aggressive than castrated males and are more likely to injure themselves, other cattle or cattle handling personnel. In range operations, intact males present managerial problems that may include homosexual behavior, incest and unwanted pregnancies within the herd.

The standard for beef quality is also an important consideration. Carcasses from intact males, 9 to 30 months of age, are graded as bullocks. Bullock carcasses may be USDA quality graded but are discounted relative to steer and heifer beef.

There are several methods used to castrate bull calves. One of the nonsurgical procedures uses an instrument called a burdizzo. This procedure requires the male calf to be restrained as the specially designed tool is placed on the scrotum above the testicles and is closed, crushing the spermatic cord. This action severs the blood supply to the testicles causing them to degenerate. The burdizzo requires skill to use properly, the procedure is slow and may result in only partial castration. Post-castration discomfort or pain from the use of the burdizzo is comparable to other castration methods.

One other nonsurgical castration procedure uses a tool known as an elastrator. Large, strong rubber bands are slipped over the testicles and released on the scrotum above the testicles, stopping the blood supply to the testicles. After several weeks, the testicles and scrotum degenerate and separate from the body. Like the other nonsurgical procedure, failures can occur if the rubber band breaks or is not applied properly. Post-castration discomfort is prolonged by this method.

Surgical removal of the testicles using sharp cutting instruments and emasculators involves opening the scrotum and removing the testicles by severing them from the spermatic cords. Aseptic techniques and trained personnel should be used to reduce the possibility of post-castration bleeding or infection. Clean and well maintained cutting instruments and emasculators should be used. The wound should be treated with an antiseptic solution. Castration failure is less likely to occur from this procedure than the nonsurgical procedures because the testicles are removed at the time of surgery. Post-castration discomfort is normally not as long as it is when elastrators are used.

Chemical castration has been used in the past but currently there are no products available. The procedures are bloodless but require extreme skill because chemical substances must be injected directly into the testicles. These procedures are slow and errors are easily made.

Regardless of the procedure used, only experienced and trained personnel should be allowed to castrate cattle. Castration of bull calves should be accomplished before they reach puberty, preferably as a young nursing calf. If bull calves are not castrated before entering the feedlot, castration should occur soon after arrival.

Post-castration care of calves should include special attention and management during the week after the procedure. Nursing calves should be returned to their dams in clean areas. Calves should be checked to ensure that they are nursing or eating, that bleeding has stopped, and that the wound is healing normally.

When sexually mature heifers are not selected to enter breeding herds, they are normally managed to eventually enter a feedlot. Before entering the feedlot, they may become pregnant.

Pregnant heifers may calve in the feedlot, depending on the stage of fetal development when they are received by the feedlot and the length of time they remain in the feedlot. This creates a

stressful situation for the heifer and a high probability of mortality for the calf. To prevent this situation, producers can castrate (spay) heifers not selected for breeding or induce pregnant heifers to abort soon after entering the feedlot.

Spaying surgically removes the ovaries from the heifer to prevent pregnancy. Performed by a trained veterinarian, it requires abdominal surgery. It is not frequently used in California. To gain access to the reproductive tract of the heifer, one procedure requires an external incision under local anesthesia in the flank region of the animal. Another is a vaginal procedure using a special surgical instrument to gain access to the reproductive tract and surgically remove the ovaries. Both procedures can be accomplished quickly but require the heifer to be restrained during the surgery. Unlike the recommendation of early castration of bull calves, spaying should be done when the heifer is physically more mature in order for the procedure to be quickly and easily accomplished.

Inducing abortion involves the single injection of an FDA approved drug which affects the physiological function of the ovary during pregnancy. When the drug is administered early to midterm, the pregnancy can be terminated with little observable stress or discomfort.

Implanting

The steroid hormones normally produced by the testes or ovaries are not present at the same level in castrated animals as in intact animals. Because of this, castrated animals can have a slower growth rate than intact animals.

Several hormonal and hormonal acting ear implants are available for beef cattle. They are regulated by the FDA. These implants increase weight gain and efficiency when cattle are receiving adequate nutrition. Also, implants tend to increase lean and decrease fat content of beef. Implants come in the form of small pellets or a single insert. These are implanted in the backside of the ear between the skin and cartilage. Implants should be placed in the ear according to label instructions.

Identification

The positive identification of beef animals is necessary for several reasons. As proof of ownership, most beef producers brand their cattle with a hot iron. The California Bureau of Livestock Identification regulates the use of brands and provides inspectors who monitor the sale of cattle to verify proper ownership.

Identification also is required for many management reasons. Genetic improvement and selection require the identification of sires and dams and their sons and daughters. Diseased animals need to be identified and removed from the herd and properly treated. Feedlot cattle are identified to provide management with health and feeding information.

Cattle rustling is a concern to animal producers. Stolen animals may suffer mistreatment while being transported and hidden. Unidentified animals are at a much greater risk of theft.

Methods used to identify cattle include hot iron branding, ear marking, tattooing, ear tags, wattles and freeze branding.

Hot iron branding is the only legal method for proof of ownership. All brands must be registered with the California Bureau of Livestock Identification. To produce a legible brand, a heated branding iron is applied to the skin for several seconds when the animal is restrained. The length of time the branding iron is in contact with the skin depends on the time of year, the breed of cattle, and the length of the hair on the animal. Only experienced or trained personnel should brand cattle.

Earmarks augment hot iron brands and may be registered with the brand. Earmarks are made by marking the ear with a specific notch, slit, or other surgically produced mark. This may be done at branding time. It may produce short-term stress, but may decrease the stress of excessive handling required for positive identification when other forms used for identification are not legible.

Tattooing the inside of the ear is a permanent form of identification used in the Brucellosis vaccination program in California and is also commonly used to identify individual animals in purebred herds. It requires specialized equipment and restraint of the animal.

Ear tags of many different styles and types are commonly used for identification. Ear tags are not considered to be permanent

identification because they can be removed or lost, but they are useful for management purposes. Tags are commonly supported by a plastic or metal shaft which pierces the ear and is held in place by a fastener on the back of the ear. The tags are relatively easy and quick to apply and require less restraint of the animal than other forms of identification. The tags should be applied in a area of the ear that is free of blood vessels to reduce bleeding.

Wattles are used as an alternative ownership identification tool in colder climates where longer winter hair growth makes brand recognition difficult. This form of identification is made by surgically separating both layers of skin from the connective tissue a distance of 2 to 4 inches. Wattles are commonly placed on the dewlap, neck or shoulder. This practice creates a short-term stress when the procedure is performed, but may prevent repeated handling of the animal to identify the owner. It is used mainly in the cold intermountain region of California and is not a necessary or generally utilized form of cattle identification in other regions.

Freeze branding is a method requiring more expertise and more restraint of the animal than hot iron branding. This practice is not used as often as other methods to identify cattle. The hair must be clipped and a liquid, cold-transfer agent must be used on the site to be branded. Branding irons are chilled in a dry ice and alcohol solution and then are applied to the skin of the animal to produce the brand. This method of identification requires a longer period of branding iron contact with the skin than the hot iron method. Because this method changes pigmentation of the hair, resulting in the hair turning white, animals with light colored hair do not show freeze brands well. Adequate brands on cattle with dark hair are readily visible from some distance.

Hot iron face branding may be required by the USDA to identify animals for specific purposes. These include identifying animals with certain contagious diseases, for herd reduction programs or for feeder cattle imported from Mexico. This method is not suitable for ownership or individual identification purposes and is not used by producers.

Dehorning

Calves of either sex can be born with or without horns, depending on their genetic makeup. If horns are not removed they may be used to determine social dominance and severely bruise or injure other animals. In confinement, cattle with long horns can be injured by getting their horns caught in fences, gates, and chutes. Cattle with horns may also cause severe injuries to penmates and personnel. If horns are not removed from purebred cattle, they can be trained to an acceptable shape using weights at the appropriate stage of their development.

Dehorning can be accomplished using several methods or their combination, depending on the age of the animal and the size of its horns.

Caustic dehorning liquid or paste can be applied to the horn "button" of calves during the first few weeks of life to stop horn growth. This method is used primarily on intensive ranches where calves can easily be handled.

Hot iron or electric dehorners can be used on young calves to destroy new horn tissue, preventing further growth of the horn.

Procedures used on older calves with developing horns involve tools of various sizes that scoop or remove the horn from below its base and assist in sealing the adjoining blood vessels to reduce bleeding. A cautery tool may also be used at this time as an aid to stop bleeding from the wound.

Larger, well-developed horns of older animals that do not require total removal can be tipped using a tool to remove the end of the horn to the desired length.

Regardless of when dehorning takes place, only experienced or trained personnel should perform this procedure. When a surgical procedure is required for the removal of horns, aseptic methods using well-maintained tools or instruments are necessary. Following removal of the horn, the wound should be treated to prevent excessive bleeding or infection.

Cattle in feedlots should be dehorned soon after arrival to avoid prolonged stress on the animals. If feasible, dehorned cattle should be checked daily the first week to assure that wounds are healing properly.

Weaning

As nursing calves grow older, the cow's milk production decreases. Calf removal or weaning allows the cow to build up her body reserves before the birth of her next calf. Weaning is accomplished by permanently separating the calf from the cow. This can be a stressful time for both the cow and the calf, since the bonding which existed from birth is interrupted and removed.

Weaning does not cause physical pain to the animals, but there are observable indicators of behavioral stress when the calf and its dam are separated. This stress can be managed or reduced in a number of ways.

The field or pen in which the weaned calves are placed should be located where olfactory and visual contact with the cow is minimized. Adequate facilities also are necessary. They should allow for feeding and watering the calves, dust control, if necessary, and should be structurally strong enough to prevent the reuniting of the calf with its dam.

Facilities

A well-designed and maintained handling facility can include corrals, pens, processing facilities, scales, and shipping and receiving facilities. With proper design and ongoing maintenance of the facility, cattle can be efficiently handled without stress and injury. Facilities should be designed to accommodate the type and size of cattle processed and/or confined. The number of cattle using the facility and its local environment are also important considerations in its design. For example, if the facility is normally used early in the mornings, it should be constructed so the flow pattern of the cattle will not face to the east or southeast. Cattle may balk if they are facing the sun as they move through the handling facility.

Materials used in construction of corrals and pens can vary greatly. Consideration of environmental conditions is important. For example, in the desert region, wooden fences which restrict air flow may increase heat stress. In colder climates, animals can benefit if there is protection from wind, rain or snow while they are confined.

The design of pens, alleys, and chutes should be as simple as possible to create an efficient flow pattern when moving cattle. Cattle tend to circle and will follow the leader, so they should be allowed to see animals ahead of them. While open-sided chutes can be used satisfactorily by competent personnel, curved solid chutes are more efficient. Cattle will stand more quietly and move more easily through a single-file chute when their peripheral vision is restricted. Solid sides prevent the animals from observing people, vehicles, dogs and other external stimuli or distractions with their wide angle vision.

Private insurance carriers, numerous state laws, and CAL-OSHA also mandate a safe working environment for the personnel handling the cattle.

Facility requirements for confined cattle

Facilities in feedlots are more extensive then those in range operations. The basic needs for handling and processing cattle are similar, but additional feedlot facilities are required to accommodate the needs of large numbers of cattle in a comparatively small area during an extended feeding period.

The space required by feeder cattle in unsurfaced (earth) pens depends on the climate and soil type where the facility is located. In dry climates, 75 square-feet per animal is adequate, but in wet, muddy climates 300 square-feet per animal may be necessary. Feedlots are typically built

to accommodate 100 to 300 cattle in one pen but smaller pens can be acceptable.

Feed bunk space should be designed to allow all animals in the pen to consume feed with minimal animal conflict. If feed is always available, 6 to 10 inches per animal is adequate bunk space. If the cattle are limit-fed twice a day, enough space is needed to allow each animal in the pen to stand at the bunk as the cattle are fed. Depending on animal size, 20 to 30 inches per head is usually adequate. A 6 to 8 foot sloped concrete apron for the cattle to stand on while feeding that is adjacent to and behind the bunk can reduce muddy areas near the feed bunk. Cattle should step up to the bunk. The front feet should be about 4 inches above the rear feet. The slope of the concrete apron reduces muddy areas in pens, helping eliminate physical stress.

Cattle should always have access to clean, fresh water. For troughs, one linear foot per ten animals is adequate. Each trough should have a drain to prevent overflows and mud. Each water trough should have a concrete apron to reduce muddy pen conditions. Pipes leading to the trough should be buried or placed out of the sun. Water troughs in northern latitudes or higher elevations should come equipped with water heaters to prevent the water from freezing.

Muddy pens may be as detrimental to cattle well-being as extremely hot or cold temperatures. In areas with greater than 6 inches of annual rainfall, a 3 percent slope should be adequate to reduce muddy surfaces. However, excessive slopes will accentuate surface runoff and erosion potential. State and federal laws regulate feedlot surface runoff and ground water pollution. In California, Regional Water Quality Control Boards regulate feedlot drainage.

To reduce heat stress, feedlots in areas where there are more than 90 days per year of temperatures greater than 100°F should have shades in the pens. Under hot conditions, cattle in confinement require 25 to 40 square-feet of shade per head. Shades should be about 12 feet high. To ensure availability of shade throughout the day, the shades should be built with a north-south orientation and offset toward the west.

Lights may cause stress in a confinement situation. If lighting is required for working cattle before dawn or for security purposes, it should be evenly diffused. It should not create harsh shadows and bright spots nor should it be directed into the eyes of the cattle for prolonged periods.

Equipment and tools used in handling and moving cattle

Animal restraints of some form are necessary for many of the practices involved in beef production to be performed safely. The tools used must quickly and easily restrain the animal without injury to it or the operator. The animal can be restrained securely during the procedure and then easily and quickly released when the procedure is finished. Depending on the type of facility, restraints can include ropes or mechanical devices. The mechanical device used depends on the size of the animal and the number of animals to be handled.

Calf tables are used by some cow-calf operators to work calves while others prefer using ropes to restrain the animals. As animals get larger, most producers use squeeze chutes of various designs to restrain cattle. The frequency and number of cattle processed determines whether manual or hydraulic squeezes are used. Regardless of which device is used to restrain cattle, only experienced or trained personnel should use these tools to prevent injuring or choking the animal while it is being treated.

Producers occasionally need to move cattle. Since relocation may be stressful, measures should be taken to minimize the potential for stress during the move. Cattle should be moved slowly and not forced to run. Depending on the situation, the move may be made on foot, horseback or by mechanized means. When cattle balk or try to turn back, the judicious use of whips or backslappers of various types or dogs trained to move cattle may be used.

Cattle moving through a chute may balk or lie down. Cattle that balk take longer to work and are more prone to hurt themselves or cause injury to other animals. They may also injure personnel handling the cattle. This risk may be reduced with the judicious use of an electric prod to keep cattle moving forward. The prod should be used only on cattle that balk or otherwise impede movements in the chute during processing or loading and unloading. Personnel should be instructed not to shock all animals in the chutes. Electric prods are generally not useful to move cattle in alleys or pens. In order for the prod to work effectively, the batteries should be changed often to maintain its electric charge and the prongs of the prod need to be kept clean to allow good contact. For the most effective use in the movement of livestock, the prongs of the prod need only light contact on the skin of the animal. The electric prod should not be used to poke or probe the cattle.

Transportation

The transportation of cattle to and from farms, ranches, feedlots, and to processing facilities is an important operation in beef cattle production. Proper handling and transportation are important for the safety and welfare of the animals being moved. Improper handling and transportation can cause illness and/or injury to the cattle.

Commercial livestock transportation companies, which are regulated by state and federal agencies, use trucks and trailers that have the capacity to carry a large number of animals. Producers also transport cattle using their own equipment. Normally this will be stock trailers and/or small livestock trucks that have less capacity than the commercial livestock trucks. Regardless of the equipment used for transportation, cattle should be handled to ensure their safety and welfare through all phases of transport.

In preparation for shipping, cattle should be separated by weight and/or gender. If possible, the different groups should be loaded into separate compartments of the truck or trailer. Sick or injured cattle require special handling which may include separate loading and transporting and care to prevent additional stress or injury.

When loading cattle, personnel should move cattle as quietly and patiently as possible to prevent injury to the animal. When cattle are given the opportunity, they will use their natural herding instincts to move through alleys and chutes leading into the trucks or trailers.

Appropriate sized equipment is important to prevent overcrowding. The cattle need adequate space to allow them to stand again should they fall during transit.

In preparation for moving cattle, attention should be given to weather forecasts. Extreme high or low temperatures can cause stressful conditions for the cattle in transit. Adequate ventilation must always be provided. During transit, the ride for the cattle should be as smooth as possible. To help prevent cattle from falling, the floors of the trucks and trailers should be slip resistant. Drivers should avoid sudden starts and stops and sharp turns at high speed.

It is important to move cattle quickly to reduce transportation stress. Planned stops during transit should be made to ensure that the cattle are well dispersed and standing. All equipment should be mechanically sound before departure. This will help prevent

additional stress from prolonged transit time caused by equipment failure.

Upon arrival at their destination, cattle should be unloaded quietly. Cattle have a tendency to rush from a vehicle so additional care must be taken to ensure that cattle unload evenly and slowly.

Shrink, the loss of body weight from excretory losses in manure and urine without intake of feed or water, can occur during transit, at weaning, or other periods when cattle may be stressed for a short time. Temporary losses of 3 to 10 percent or more of body weight can occur during these periods. A more serious health threat occurs when the weight loss is from tissue shrink. This can occur during long periods of fasting caused by hauling cattle long distances.

When unloaded, the cattle should be checked for injury or sickness. Additional care should be provided for sick or injured cattle. After a long haul, fatigued animals should be allowed to rest and have access to hay and water before they are processed or released into pastures.

CONCLUSION

The cattle production practices described in this publication are commonly used in California. The authors consider these practices as the most appropriate and practical of those currently available.

Research involving beef cattle production is ongoing at many universities throughout the United States. New food animal production practices and techniques are being developed to improve efficiencies of production and to minimize stress.

When new information is developed, beef producers have the responsibility to evaluate which husbandry practices they adopt. Decisions should be based on professional judgment, training, and experience in the safe, humane, and efficient production of beef.

BIBLIOGRAPHY

Agricultural Resources of California Counties. 1982. Special Publication 3275. University of California, Division of Agriculture and Natural Resources.

Albaugh, Reuben, R. B. Bushnell, and E. C. Loomis. 1980. Factors Affecting the Cattle Producer's Income. Leaflet 2313. University of California Division of Agriculture and Natural Resources.

Albaugh, Reuben, 1975. How to Identify Livestock. Leaflet 2297. University of California.

Baker, F. H. 1986. Guidelines For Uniform Beef Improvement Programs. 5th Edition. Beef Improvement Federation. North Carolina State University. Pg. 12-5.

Bath, D. L., J. R. Dunbar, J. M. King, S. L. Berry, R. O. Leonard and S. E. Olbrich. 1980. By-products and unusual feedstuffs in livestock rations. Western Regional Extension Publication, No. 39.

Bearden, H. J. and J. W. Fuquay. 1980. Applied Animal Reproduction. Reston Publishing Co., Reston, Virginia. Pg. 199-319.

Blakeley, James and David H. Bade. 1979. The Science of Animal Husbandry. Reston Publishing Co., Reston, Virginia.

California Department of Food and Agriculture. Food and Agriculture Code Book, Section 2433.

California Department of Motor Vehicles. California Vehicle Code, Section 2810.

California Livestock Statistics Bulletin. 1990. California Agricultural Statistics Service.

CAST. 1985. Antibiotics for animals. Council for Agricultural Science and Technology, Iowa State University, Ames, Iowa.

Church, D. C. 1979. Livestock Feeds and Feeding. O & B Books, Corvallis, Oregon. Pg. 173, 191

Cole, H. H. And P. T. Cupps. 1969. Reproduction in Domestic Animals, 2nd Edition. Academic Press, New York. Pg. 217-219, 287-289, 480-481.

Cole, H. H. and W. N. Garrett. 1980. Animal Agriculture, 2nd Edition. W. H. Freeman and Co., San Francisco. Pg. 239-252.

Curtis, S.E. 1988. Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching. Agricultural Animal Care Guide, Div. of Agr., Nat. Assoc. of State Univ. and Land Grant Coll., Washington, D.C. Pg. 25.

Dunbar, J. R. and S. L. Berry. 1979. Essentials in Beef Cow Management. Leaflet 2953. University of California Division of Agriculture and Natural Resources.

Dunbar, J. R. 1981. Management of Beef Herds. Leaflet 2933. Division of Agricultural Sciences, University of California

Fairbanks, W. C. and D. G. Addis. 1979. Feedlot facilities. University of California Cooperative Extension.

Federal Motor Carrier Safety Regulations. March 1988. California Trucking Association.

Fraser, D., Ritchie, J. S. D., and Fraser, A. F. 1975. The term stress in a veterinary context. Brit. Vet. J. 131:653-662.

Fraser, A.F. 1985. In: Ethology of Farm Animals. Elsevier, New York. Pg. 83-108, 183-275.

Graham, J. F. 1982. The effect of body condition of beef cows at calving and post calving nutrition on calf growth rate and cow fertility. Proc. Aus. Soc. Anim. Prod. 14:309-311.

Grandin, T. 1980. Livestock behaviors as related to handling facilities design. Int. J. Stud. Prob. 1:33-52.

Hafez, E. S. E. 1974. Reproduction in Farm Animals, 3rd Edition. Lea and Febiger, Philadelphia. Pg. 257-263.

Herd, D. B. and L. R. Sprott. Body Condition, Nutrition and Reproduction of Beef Cows. B-1526. Texas Agricultural Extension Service. The Texas A&M University System.

Hutcheson, D.P. and N. A. Cole. Management of Transit-Stress Syndrome in Cattle: Nutritional and Environmental Effects. Texas Agricultural Experimental Station and U. S. Department of Agriculture.

Keneko, J. J. 1980. Clinical Biochemistry of Domestic Animals, 3rd Edition. Academic Press, San Francisco. Appendix VI.

Livestock Welfare Road Transport. Code of Minimum Standards. New Zealand Ministry of Agriculture and Fisheries.

Lowman, B. G., N. Scott and S. Somerville. 1976. Condition scoring of cattle. East Of Scotland College of Agric. Bulletin 6. The Edinburgh School of Agriculture, Edinburgh.

Mary, C. C. and D. A. Irwin. 1972. Commercial Beef Cattle Production. Lea and Febiger, Philadelphia.

NRC. 1984. Nutrient Requirements of Beef Cattle, 6th Edition. National Academy Press, Washington, D.C.

Oltjen, J. W., A. C. Bywater, C. R. Benson, and J. W. Clawson. 1982. An Analysis of the California Beef Industry. Special Publication 3281. University of California Division of Agriculture and Natural Resources.

Richards, M. W., J. C. Spitzer and M. B. Warner. 1986. Effect of varying levels of postpartum nutrition and body condition at calving on subsequent reproductive performance in beef cattle. J. Anim. Sci. 62:300-306.

Rutter, L. M. and R. D. Randel. 1984. Postpartum nutrient intake and body condition: Effect on pituitary function and onset of estrus in cattle. J. Anim. Sci. 58:265-274.

Stricklin, W.R. and J.A. Mench. 1987. Social organization. Vet. Clin. N. Amer.: Food Anim. Prac. 3:307-322.

Thompson, G. B. and C. C. O'Mary. 1983. The Feedlot. Lea and Fabiger, Philadelphia.

Underwood, E. J. 1977. Trace Elements in Human and Animal Nutrition, 4th Ed. Academic Press, New York.

Van Reit, W. J. 1980. Beef Production in California. Leaflet 21184. University of California Division of Agriculture and Natural Resources.

Webster, A. J. F. 1983. Environmental stress and the physiology, performance and health of ruminants. J. Anim. Sci. 57:1584-1593.

Zillman P., J. C. Rosse, and A. A. Christiansen. 1973. Livestock Conservation Inc.

Zinn, R. A., J. R. Dunbar, and B. B. Norman. 1985. Relative effects of dehorning and castration on early health and performance of feedlot calves. University of California, California Feeders' Day.

Zinn, R. A., J. R. Dunbar, and B. B. Norman. 1985. Influence of time of processing on early health performance of feedlot calves. University of California, California Feeders' Day.

Zinn, R. A., J. R. Dunbar, and B. B. Norman. 1986. Influence of time of processing on health and performance of feedlot calves. University of California, California Feeders' Day

Zinn, R. A. 1987. Influence of castration on performance on yearlings in the feedlot. University of California, California Feeders' Day.

GLOSSARY

Abort	Termination of the pregnancy.
Body condition	The body reserves (body fat) of an animal at specific stages of its production cycle.
Breed	A group of animals that have a common origin and similar genetic characteristics which distinguish them from other groups within the same species.
Bull	Uncastrated male bovine of any age.
Calf	Young bovine of either sex under the age of one year.
Castrate	To surgically remove the testicles or ovaries or to cause the testicles to become nonfunctional.
Colostrum	The milk containing maternal antibodies produced by the cow prior to and during the first few days after calving.
Confinement	For the purposes of this publication, refers to cattle confined for a specific period during production, i.e. feedlots as opposed to occasional confinement in corrals.
Cow	Female bovine that has produced one or more calves.
Crossbreeding	A system of breeding, combining two or more breeds.
Cull	To remove less productive or undesirable cattle from a herd.
Dam	The female parent of the calf.
Energy	The component of feed ration that gives animals the ability to grow, lactate, reproduce, and maintain themselves.
Environment	All conditions of production, including feeding, housing, management, and climate, which affect the life and performance of cattle exclusive of their genetics.
Estrous cycle	The reproductive cycle of the cow.
Feeder cattle	Cattle in feedlots.
Feedlot	A confinement facility where cattle are fed.
Fertility	All factors affecting conception and reproduction.
Gestation	The period of time between conception and calving.

Heifer	A young female bovine that has not had a calf. A "first-calf heifer" has had only one calf.
Morbidity	The incidence of disease.
Mortality	Death.
Necropsy	The examination of an animal after death.
Nutrients	The chemical substances found in feed necessary for the maintenance, production, and health of animals.
Parasite	An animal which nourishes itself by feeding on host animals.
Parturition	The act of giving birth; calving.
Polled	Naturally hornless cattle. Having no horns or scurs.
Process	The act of administering a specific or series of production practices to an animal.
Roughage	Feeds high in fiber content and low in energy and protein digestibility.
Rumen	The first and largest of the four compartments of the stomach of cattle where microbial fermentation of feed occurs.
Ruminant	Animals, such as cattle, that ruminate and digest cellulose.
Ruminate	To regurgitate and remasticate roughages.
Sire	The male parent of the calf.
Squeeze chute	An adjustable restraint device used to safely catch and confine an animal during processing.
Steer	A male bovine castrated before the development of secondary sex characteristics.
Stockers	Cattle which, after weaning, graze forage or are fed roughages until they enter a feedlot.
Wean	The permanent removal of a calf from its dam.