Grant-Kohrs Ranch Livestock Practices Document

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Background

Document Summary

The following document, prepared by student, Callie Griffin, and Principal Investigator, Dr. Rachel Endecott, from Montana State University, is designed to serve as a consolidated livestock practices document for the Grant-Kohrs Ranch. Sections are divided by seasons with the spring, summer, fall, and winter seasons encompassing the months of April – June, July – September, October – December, and January – March, respectively. Each section provides applicable recommendations and practices that are relevant to the primary duties of each season. Current animal use plans, livestock nutrition and health programs, and behavior practices have been analyzed, and details concerning those responsibilities are explained. The following topics under the "Background" chapter are applicable to each season and should be referred to when needed. It is important to remember to contact your local veterinarian or other appropriate personnel with questions that may arise.

Grant-Kohrs Ranch Background

In 1852, Johnny Grant, a Canadian fur trader, came to Montana via the Oregon Trail. Grant began wintering his cattle in the Deer Lodge Valley, and later made that valley his permanent residence. The ranch was sold in 1866 to Conrad Kohrs, who became a well-known rancher in the region. His grandson, Conrad Warren, took operation of the ranch in the 1930s and then gained ownership in the 1940s. The Grant-Kohrs Home Ranch was designated as a National Historic Landmark on December 19, 1960 because of its association with Johnny Grant and Conrad Kohrs. In 1972, Congress designated the ranch a National Historic Site for its association with the open-range cattle industry. The park's purpose is to "provide an understanding of the nation's frontier cattle era commemorating cowboys and cattlemen through the preservation, interpretation, and operation of an intact ranch with more than 150 years of unbroken history."[6, 8]

Today, the ranch continues to operate similarly to how it did years ago. Cattle ranching still occurs and some hay is put up by using a horse. The Grant-Kohrs Ranch National Historic Site is open year-round to visitors, and has special days that visitors can observe activities like branding, calving, and haying. Although the ranch operates somewhat to how it did in the 19th

and 20th centuries, some changes and additions have been made over time. The ranch focuses on visitor interaction and strives to give visitors an understanding of how the nation's frontier cattle era operated and evolved into modern times. Program managers strive to balance visitor enjoyment and understanding with livestock and natural/cultural resource preservation needs, while staying fiscally responsible and abiding by law, policy, and guidelines.

Records are kept and programs like CattleMax have been incorporated. CattleMax organizes records and aids in decision making for producers. All routine vaccinations and treatments in response to illness or injury should be recorded in the CattleMax program, along with lot numbers of vaccinations. Other records such as daily herd checking and calving records are also kept. The Grant-Kohrs Ranch vaccinates their herd for disease prevention, and continuously works to meet Beef Quality Assurance (BQA) standards. Vaccines administered are always recommended by a veterinarian.

In addition to complying with BQA standards, the Grant-Kohrs Ranch is also guided by the National Park Service Institutional Animal Care and Use committee (NPS IACUC/the Committee) standards and policies. The NPS IACUC/the Committee provides guidance to assist NPS units to comply with the Animal Welfare Act (AWA), its regulations (AWAR), and the Interagency Research Animal Committee (IRAC) principles for projects involving the use of vertebrate animals in research, teaching, and/or exhibition. Animal welfare is of utmost importance, and should always be kept in mind when handling animals. There are also a few park guidelines provided in the Superintendent's directives.

Historic Cattle Breeds of the Ranch

To parallel the history of the Grant-Kohrs Ranch, and to help serve as an interpretive story of the ranch years ago, three breeds are used within the breeding program. Each year, the herd is bred to Hereford, Shorthorn, or Longhorn bulls. The breed of bull used is rotated every three years. For example, cows may be bred to Hereford bulls from 2014-2016, Shorthorn bulls from 2017-2019, and Longhorn bulls from 2020-2022. This rotation is then repeated, and bulls are sold after 3 years of use. This increases heterosis within the herd, which potentially increases the ability for the progeny to show qualities superior to those of both parents. Crossbreeding is utilized to increase progeny performance, which may lead to higher weight gains, etc.

The Hereford breed of cattle originated in England during the 1700's. Conrad Kohrs owned Hereford cattle in as early as the 1880s, and Conrad Warren owned Hereford cattle in his well-recognized purebred operation. The breed is known for its excellent doing-ability and early maturity. This is a beneficial characteristic when considering meat quality. Animals that are smaller framed and early maturing take less time to finish in a feedlot or grass-based system.

This proves to be positive for producers, feeders, packers, and consumers. Cattle that take less time to finish have lower input costs. They also are slaughtered at a younger age, and therefore tend to have more tender and consistent meat. Today's versatile Hereford possesses several optimum traits that prove to be advantageous to some producers around Montana and the United States. They have optimum size and growth, milk, muscling, and disposition traits, as well as, showing advantages with reproductive performance, feed efficiency, and soundness.[3]

Shorthorn cattle are known for slightly different traits than Herefords. Grant, Kohrs, and Warren all owned this breed of cattle because of their versatility. Like Herefords, the Shorthorn breed originated in England. This breed is still highly valued for its milking ability and meat quality, thus acquiring the dual-purpose name. Shorthorn cows are known for having high fertility rates, early maturation, and sufficient milk. They are also mild tempered and have high marbling traits. Many people believe they have the ability to cross well with many different breeds.[4]

The Longhorn breed originated in Texas and has many qualities that differ from that of Herefords and Shorthorns. While they played an important role in the national story of ranching, Longhorns were not often a part of the Grant or Kohrs operations. Longhorns have outstanding longevity, are very adaptable, and produce lean meat. They utilize available forage to the best of their ability and also have some disease and parasite resistance built up. Because they originated in Texas, they are adapted to a warm climate – a climate that Western Montana does occasionally experience. At the Grant-Kohrs Ranch, Longhorn bulls are typically bred to the replacement heifers because Longhorn calves are usually smaller and easier to deliver, which is important for heifers having their first calves.[5]

Biosecurity & Security Recommendations

Biosecurity and security are very crucial to any operation. It may prove to be beneficial for ranches to have biosecurity protocols in place to eliminate or limit the transmission of harmful diseases. Security protocols should exist to help keep not only animals, but also employees and visitors safe and secure. The following lists give some recommendations for the Grant-Kohrs Ranch concerning biosecurity and security protocols.

Biosecurity Issues:

- Have a biosecurity plan posted and stick to it. By assessing your risks, an idea of how serious the risk could be should be seen. Possible risks include: animal movement, facilities, feeding and bedding, and human movement. After the risks have been identified, they must be managed. The plan must be known to employees and visitors.
- Properly vaccinate animals. By doing this, control and prevention against a targeted disease will be more possible. Without proper vaccination, all other measures taken to reduce the occurrence of disease or the spread of disease will be extremely difficult. Make sure to keep proper administration, storage, and handling of vaccines in mind.
- Limit off-site additions to the herd. New additions have the ability to introduce new diseases that the original herd has never been exposed to, and should be quarantined for 2-4 weeks.
- Make and have an isolation pen for sick or infected animals available. Disease or sickness transmission may be reduced if sick animals have been removed from the herd.
- House common aged animals together after weaning. Young animals are more susceptible to diseases than older animals. By keeping them separate, neonatal diseases will be greatly reduced.
- Keep animal housing facilities clean at all times. Cleaning and disinfecting is an effective way to reduce pathogens in buildings, minimize the possibility of disease to animals that occupy the space, and promote animal health.
- Provide enough room for shelter and bunk space. This helps with cleanliness and direct contact and exposure.[2]
- Maximize feed and water freshness and quality, as pathogens may enter farms through contaminated feed and water. Be sure to properly dispose of garbage.

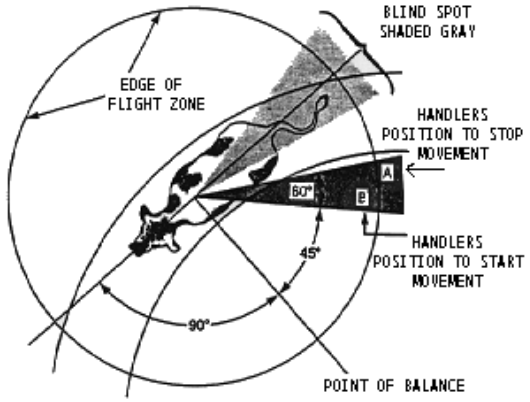
- Control wild animals, birds, dogs, cats, rodents, and insects, as they can act as vectors of disease. Control programs should be introduced when needed. It may be beneficial to contact an individual with expertise in pest control if it is necessary to implement a program.[7]
- Be aware that it is possible for any visitor to bring in harmful bacteria, virus, protozoa, etc. on their shoes, clothing, vehicle, etc. It may be beneficial to have a "plan of action" in the case of a disease outbreak.[2]
- Make certain visitors bringing non-NPS animals on-site comply with the GRKO policy regarding privately-owned animal use and boarding.
- Ensure visitor safety and cleanliness by providing hand sanitation before and after animal contact.

Security Issues:

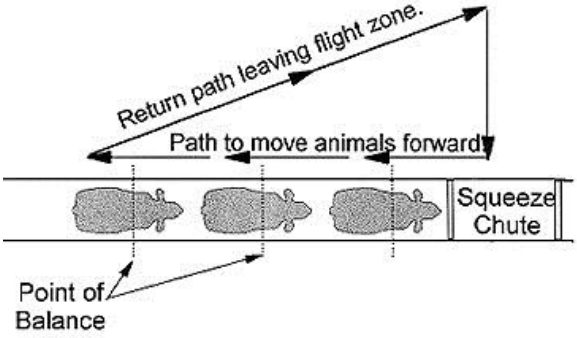
- Keep fences maintained and gates closed. Fix fences as soon as possible when needed.
- Educate visitors on rules and regulations while at the Grant-Kohrs Ranch to help ensure safety of the animals and of the visitors.
- Provide appropriate contact information for all staff at the ranch.
- If an animal is within the railroad right of way or if movement across the railroad tracks will be occurring, contact the railroad at 1-800-537-6224 for further instruction.

Cattle Handling Recommendations

Low stress handling of cattle should be of utmost importance no matter the season or purpose for handling. It has been proven that reducing stress during handling will improve productivity and prevent physiological changes that could lower productivity of the animal. According to Temple Grandin, stress from handling can lower conception rates and reduce immune and rumen function. Grandin also believes that handlers who understand livestock behavior can reduce stress. All cattle react differently to being handled and have different flight zones, so by understanding their specific reactions to people, stress can be greatly reduced.[1] The following diagrams and table should give some insight into low-stress handling practices and methods.



This diagram shows that in order to move cattle in the direction intended, you must be in the flight zone. It is important to move out of the blind spot when trying to move cattle. Note the position to be in to stop and start movement and remember that all cattle have different flight zones. You may not need to be as close to some to get them to move away from you.



This diagram shows the steps to be taken to easily move cattle through the alley and chute. When moving towards animals, they will naturally move past you and forward in the chute. Note the point of balance.

Factors:	**Reason for Stress:**	**Recommendation:**
Vision	Wide angle of vision allows for many distractions (shadows, coat hanging on fence, people, car, etc.) to be seen	Remove all potential reasons for agitation: shadows or brightness, slats on floor, flapping objects, other objects that may be a distraction
Noise	Cattle dislike loud noises that are sudden or constant, noise like yelling increases the animal's heart rate	Handle cattle with as little noise as possible (do not yell, fix loud gate, etc.)
Flight Zone	All animals have different flight zones and they may get stressed if someone or something is repeatedly in that zone	Understand the flight zone of individual animals and work on the edge of the flight zone
Herd Separation	Cattle are herd animals and may get agitated when singled out from the rest of the herd	Put other animals with the singled out animal if it has become agitated

Genetic Differences	Some breeds are naturally more excitable than other breeds	Be aware that different breeds may have different flight zones and respect their personal space when handling
Previous Experiences	Animal may have had a negative experience in the chute, certain pen, etc., or with something like an electric prod	Try to ensure that animals will always have a positive experience when being handled
Handling Facility Layout	The layout may have distractions and reasons that cattle do not want to enter (i.e. moving from light to dark, etc.)	Curved, single-file chutes are recommended, can experiment with solid sides[1]

Other recommendations may include:

- Work cattle in the cool part of the day. Cattle, like humans, get hotter with increased movement and stress. It is important to work them when it is cooler so that heat stress can be avoided.
- Make sure employees know how to operate machinery properly. This will reduce stress on the animal by making the process easier and quieter.
- Limit use of electric prods. Prods stress all animals out more than usual and are not necessary unless the animal is extremely resistant.
- Move slowly so that the cattle will filter slowly. Running at animals or sudden movements can be frightening to cattle and cause unnecessary stress.
- Only use a chute that can be easily accessed and is safe. If greater than 25% of the animals exiting the chute slip or fall, the set-up or conditions should be assessed.[1]

There are several DVDs, YouTube videos, and books by Temple Grandin and other livestock handling experts that can be used to help incorporate low stress handling into everyday practices. The following links are YouTube videos that discuss handling cattle quietly in pens, proper orientation of cattle squeeze chutes, and cattle behavior and handling.

- Handling Cattle Quietly in Pens: https://www.youtube.com/watch?v=acDrG9b5uko
- Cattle Behavior and Handling: https://www.youtube.com/watch?v=r9ZM9DaMv-w
- Proper Operation of Cattle Chutes: https://www.youtube.com/watch?v=b5cUk9RH6lQ
- Cattle Handling in Crowd Pens: https://www.youtube.com/watch?v=Cpggjn_G6NU

- Design of Corrals and Chutes: https://www.youtube.com/watch?v=EZ1VzDSmsNk
- Low Stress Cattle Handling: https://www.youtube.com/watch?v=gycWs6q1GBw

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Spring Season

April – June

Please refer to glossary for select definitions.

For most ranchers, the spring season tends to be one of the busiest times of year. This season is typically spent calving, checking, and feeding heifers and cows. With calving comes great responsibility. You must pay attention very carefully at this time to make sure that the heifer or cow is not having any calving complications. Refer to the next sections to read in depth discussions about the following topics:

How Often to Check Heifers & Cows

When calving heifers and cows, it is a good idea to keep them in close proximity so that they can be accessed easily. More precise area requirements will be discussed in the "Area Requirements" section. As a general consensus, if there is no active calving, one should check their heifers and cows about every 3-4 hours. This includes throughout the night. Because cows have already calved in previous years, they should not need as much assistance as first-calf heifers do. More attention needs to be given to heifers.

If the weather is inclement, one should be sure to check for calving every 2 hours. If resources are available, heifers and cows should be moved inside so that they can calve in a protected environment. Chances of a calf staying alive and not freezing its ears, nose, feet, tail, or any other body part are significantly higher when the calf is kept out of harsh weather.

If a heifer or cow has begun to calve and if weather conditions are satisfactory, one should let them calve on their own, giving them about 30-45 minutes after the calf's toes are showing. This number varies widely because of labor intensity. For example, labor intensity is clearly higher

when a cow is on the ground pushing than when she is still mobile and pacing. With heifers, it sometimes proves to be beneficial to isolate them from the other heifers so that there are no distractions after or during calving. It can be common for heifers to try and mother other heifers' calves. Stress and nervousness need to be minimized.

Signs of Calving

There are many signs one should look for when a heifer or cow is close to calving.

- A few weeks before calving, the cow will "bag up." This is shown by a bigger udder which indicates increased milk production.
- When calving gets nearer, the cow or heifer's vulva will swell (referred to as "springing") and mucous discharge may be seen.
- The cow or heifer will often isolate herself to find a place to calve.
- Increased mobility and pacing will be seen.
- The heifer or cow's tail will be slightly lifted and raised away from the body.
- A small water bag will sometimes appear protruding from the vulva.
- The cow or heifer will often smell and paw the ground where she will calve.
- The cow or heifer will get up and down often.
- When the water bag bursts, a nose and front feet should be seen.
    - If a nose and front feet are not seen within ½ hour, this could indicate complications. This will be discussed in a subsequent section.

Stages of Calving

Normal calving can be divided into 3 stages – preparatory, fetal expulsion, and expulsion of the placenta (afterbirth). The time interval of each stage varies among types and breeds of cattle and among individuals of the same breed.

During the preparatory stage, the calf rotates upright and contractions begin. A water sac is expelled, as discussed in the "Signs of Calving" section. Delivery usually involves the cow laying down while the fetus enters the birth canal and then continues to leave the cow's body. A head and front feet should protrude first – if this is not the case, assistance is needed. Lastly, proper expulsion of the placental membranes (commonly called "cleaning") is necessary. The cotyledon-caruncle attachments relax and uterine contractions expel membranes. If the placental membranes fail to separate from the uterine attachment, the condition may pose health threats and cause the cow to have problems during rebreeding.[15] If the placenta has not been expelled

after 24 hours, it is referred to as a retained placenta. Retained placenta commonly accompanies difficult births, multiple births, and short gestations. In most situations, the placenta will be expelled within 12 hours after birth. The diagnosis is typically straightforward as degenerating, discolored, ultimately fetid membranes are seen hanging from the vulva 24 hours or more after parturition. The biggest repercussion of this is the increased calving interval, as it is common for a cow to delay the next pregnancy for 2 to 6 months.[12] Potential causes of retained placenta include:

- Dystocia
- Abortion (from brucellosis or mycotic abortion)
- Twins
- Stillbirth
- Hypocalcemia
- High environmental temperature
- Advancing age of the cow
- Premature birth
- Placentitis
- Nutritional disturbances

If a cow has a retained placenta of 24-48 hours and is running a fever (greater than 102.5 degrees Fahrenheit) or is not eating, she should receive immediate attention and treatment. In certain cases, an antimicrobial treatment is administered to treat the systemic signs. A veterinarian should always be contacted so that proper treatment can be given. For cows with no signs of abnormal vaginal discharges, good appetite, and good milk production, no treatment may be the best treatment of all. If the incidence of retained placenta is unusually high in a particular herd, supplementation with vitamin E and selenium may be beneficial.

Retained placenta can be prevented by doing the following:

- Reduce stress near calving
- Keep cow in good condition (BCS 5 or 6)
- Prevent exposure to pine needles before calving
- Facilitate adequate trace mineral and supplementation program
- Maintain sound vaccination program to minimize chance of viral or bacterial abortion[12]

The following table will give an idea of what should occur during each stage of calving.

Stage and time	Event
Preparatory (2 to 6 hours)	1. Calf rotates to upright position
	2. Uterine contractions begin
	3. Water sac expelled
Delivery (1.5 hour or less)	1. Cow usually lying down
	2. Fetus enters birth canal
	3. Front feet and head protrude first
	4. Calf delivery completed
Cleaning (2 to 8 hours)	1. Cotyledon-caruncle (button) attachments relax
	2. Uterine contractions expel membranes[15]

Calving Complications

Unfortunately, it is likely that ranchers may experience some calving complications. When this happens, the rancher may have to manually pull the calf. If this is unsuccessful, the heifer or cow may require veterinary assistance. A veterinarian should always be called if a person does not feel comfortable pulling a calf or if he/she anticipates needing assistance.

Something may be wrong if:

- The heifer or cow has actively strained for 40 minutes with no progress.
- 90 minutes have passed since the water bag first appeared.

The pictures shown below will give some reference to what it looks like when a cow or heifer is having calving complications. When providing assistance, it is important to only do what you feel comfortable with. Keeping the calf's health and safety in mind, a veterinarian should be called if you are unable to assist the heifer or cow.

Complications may look like:

Backwards calf

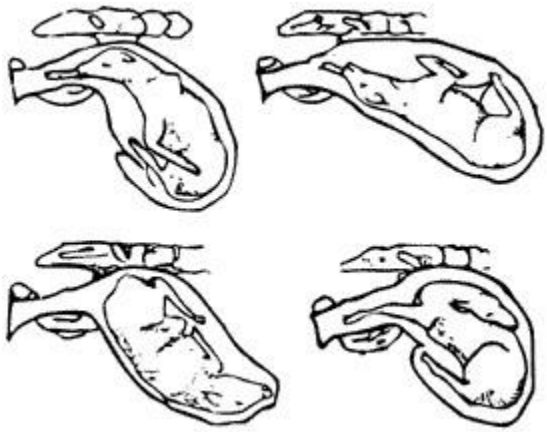
Large calf

Uterine prolapse

Other complications may include:

- Upside-down calf
- Leg/head back
- Twins

Approximately 5% of calves are in abnormal positions before birth. The diagram below shows different positions that calves may be in before birth that will cause complications. These positions include: forelegs or head turned back, breech, rear end position, sideways or rotated, etc. Remember that if a calf is in this position, it will need assistance by someone with experience to position the fetus correctly prior to delivery. If one is unable to position the fetus correctly, a veterinarian will need to perform a caesarean section (c-section).[15]



Area Requirements

When cows and heifers are calving, it is important that they have access to their own personal space if needed. Cows especially, need enough room to find a private place to calve, while heifers may need to be manually separated from the rest of the herd. When confined, a 1300 pound cow should be given 350-800 square feet of space.[2]

After cows and heifers have calved, it is best to put them in a fresh pasture with other cows and heifers that have recently calved. This can be done as soon as the calf's good health is verified, the mother is cooperating, and they can travel well. The main reason calves need to be moved to a fresh pasture is to maintain good health. If calves of all ages are kept in one pasture, scours can become a serious problem. The best way to reduce this possibility is to subdivide calving pastures and properly move cows through them. It may prove to be the most beneficial to group calves into 2 week intervals, keeping calves that are the same age together. It will then be less likely for older calves to infect younger calves. Calves are most susceptible to developing scours during their second and third week of age – a time when exposure to pathogens can be dangerous. Scours will be discussed in detail in the next section.

After Calf is Born – Ensuring Good Health

Because a calf's immunity is low and an easy target after birth, there are several events that should occur after a calf is born to ensure the calf is healthy. The events listed below (some used at GRKO Ranch) can aid in the health of calves.

- Appropriate colostrum management
- Use of iodine
- Use of selenium
- Use of Vitamin A & D
- Scour prevention

Proper colostrum management can prove to be more important than most people realize. Minutes after birth, colostrum absorption of the calf's first feeding is at its maximum (about 16 g/L). If the calf doesn't feed until 24 hours, colostrum absorption drops down to 4 g/L. There is a 50% drop in absorption in the first 12 hours of life. Calves need to consume a proper amount of colostrum as soon as possible so that immunoglobulins can be absorbed. An immunoglobulin is a protein that plays an essential role in the body's immune system, as they act as antibodies and attach to foreign substances and assist in destroying them. Lack of colostrum absorption directly correlates with mortality. Out of a group of calves that were one week old that had only received 2-4 pounds of colostrum, an average mortality rate of 15.3% was seen. Out of the same age of calves who received 8 to 10 pounds of colostrum, an average mortality rate of only 6.5% was seen. Any time a calf is not getting the proper quantity or quality of colostrum, overall health and performance are being compromised. Commercial colostrum supplements are available for purchase and should be used if a calf has not had an adequate amount. Remember; do not heat colostrum to high temperatures as this will denature the colostrum proteins and will not provide adequate nutrients.[3]

The use of iodine, applied to the navel of a calf, may be similar to colostrum management in the way of unrecognized importance. Iodine is known to decrease infection that may occur after birth. Because a newborn calf's immunity is low and they are at a disadvantage when it comes to fighting disease, iodine can be used when possible. For many reasons, iodine use on every calf born is nearly impossible, however; a good example of a time when iodine should be used is after a calf is pulled etc. Iodine applied to the navel of a calf will reduce potential infection. The navel is an opening to circulation and disease can spread rapidly by entering there.

The use of a selenium supplement can prove to be very beneficial. At the GRKO Ranch, BoSe is used to replace the lack of the important trace mineral, selenium, in the soil. Selenium deficiencies are common in certain parts of the country and can vary throughout a state. Selenium supplements are common on the western side of Montana, but are rarely used on the

eastern side of the state. The biggest potential problem a selenium deficiency poses is White Muscle Disease. With this disease, calcium salts may be deposited among the muscle fibers in parts of the bodies of affected animals, thus leading to muscle damage. Muscle weakness in the lungs of calves commonly leads to pneumonia and eventually death. A quick necropsy of a calf with White Muscle Disease will show streaks or striations on the heart. BoSe, which can be injected or given orally, will reduce the chance of White Muscle Disease and will help keep a calf healthy. To decrease the likelihood of White Muscle Disease even more, selenium injections or selenium supplementation can be given to the cow, pre-calving, to reduce the risk. Calves that are born to selenium-deficient cows may be dead or weak, or may die during the first few days of life.[8]

Scours are the leading cause of pre-weaning calf death. It is absolutely necessary to take preventative measures when concerning scours. The majority of diarrhea in calves is caused by infectious organisms such as viruses, bacteria, and protozoan parasites. Other than keeping alike-aged calves together and rotating to fresh pasture, several measures can be taken to prevent or reduce the severity of scours including:

- Check to make sure vaccinations are current so the cow's immune system can produce proper antibodies.
- Provide clean calving environment.
- Be prepared with supplies to aid in scour control and treatment.
    - Colostrum replacer if colostrum is inadequate
    - Appropriate antibiotics to fight certain bacteria and coccidia
    - Electrolytes in case of dehydration and nutrient imbalances
- Plan to check cows and calves regularly (daily at GRKO Ranch)
- Ensure calves receive sufficient, high-quality colostrum in a timely manner
    - 2-3 quarts within first 12 hours of life is recommended

Because calving takes place later in the year at the Grant-Kohrs Ranch, scours are not as likely; however, it is still important to take preventative measures. The GRKO Ranch vaccinated cows with ScourGuard 4 KC in April of 2013 and 2014. It is important to note that this protocol may change, as vaccines given are based upon veterinarian recommendation. ScourGuard 4 and similar products are used as an aid in preventing diarrhea in their calves caused by bovine rotavirus, bovine coronavirus, enterotoxigenic strains of Escherichia coli having the K99 pili adherence factor, and Clostridium perfringens type C.[16] By vaccinating cows with this type of product, antibodies against those particular microorganisms are formed. The antibodies are then transferred to the calf via the colostrum (passive immunity). Scours in calves typically follow

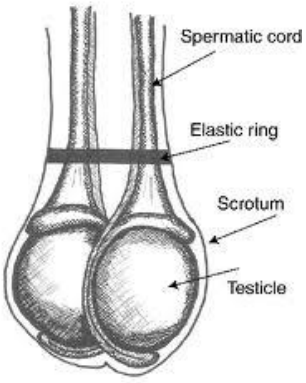
periods of cold, wind, and precipitation. The added stress of maintaining body temperature and other body functions during poor weather or wet ground conditions makes a calf more susceptible to infection. It is likely for concentrations of bacteria and viruses to increase as the calving season progresses. Calves that are born later into calving season may get exposed to a very high dose of pathogens.

After Calf is Born – Proper Management

- Ear tagging calves
- Banding calves
- Checking cows and calves regularly

Tagging calves is a form of identification and plays several major roles to aid the producer including: being able to ID the mother, knowing birth date and sire, etc. Depending on ranch preferences, different information may be included on a tag. Whatever the information is, it most often proves to be beneficial.

At the GRKO Ranch, calves are band-castrated before branding. There are pros and cons to banding, as well as pros and cons to knife-castration. Because banding is used by the staff at the GRKO Ranch, it will be discussed first. Banding is initially less stressful than knife-castration. Infection and excessive bleeding are not as common with banding as they are with knife-castration; however, cons of banding include: possibility of tetanus and bands breaking or falling off before they have served their purpose. Banding also shows stress and levels of discomfort for a longer period of time.



Knife-castration typically only causes stress for a short amount of time. It is possible that both testicles will not be removed during knife-castration; however, if an experienced person is doing the castrating, there should be no question of the job being taken care of. The problems with knife-cutting typically include excessive bleeding and infection. With either method, it is important to remember that the younger the calf, the less stress there will be. When a calf is

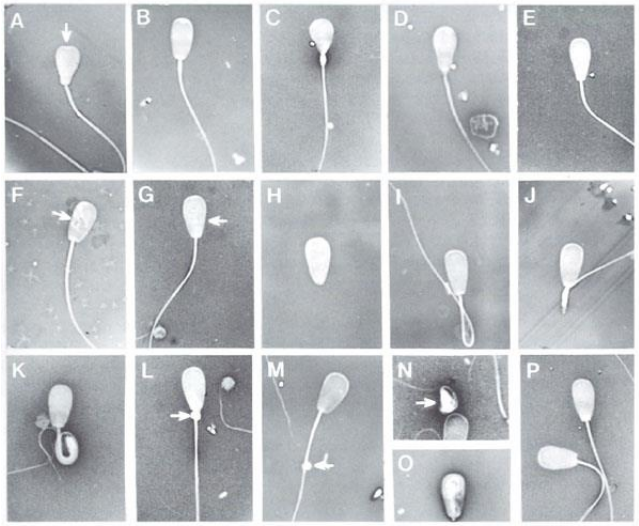
younger, recovery time will be shorter and he will be able to focus more energy on growth and weight gain.

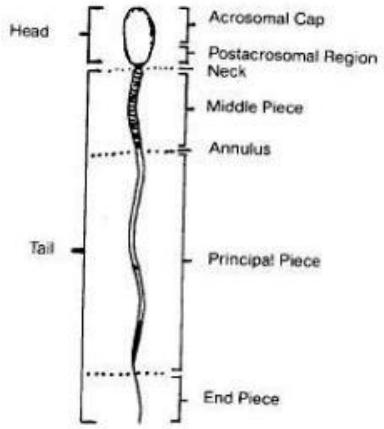
The last important activity associated with calf management during the spring season is checking cows and calves regularly. Mortality rate can be reduced when cattle are checked to ensure there are no problems. Cattle should be checked daily during calving, and as much as possible during other times of the year at the Grant-Kohrs Ranch. Findings need to be recorded in the Daily Herd Check and Finding Record. Checking frequently allows sick calves to be treated as soon as possible, which will help to increase survival rate. The following chart shows some sicknesses of cows and calves that may be prevalent in the spring.

Sickness/Disease	**Clinical Signs & Symptoms**	**Treatment & Prevention**
Bacterial Pneumonia 	Depression, drooping ears, rapid & shallow respiratory rate, serous to mucopurulent nasal discharge, moist cough	**T**: Long-acting antimicrobials **P:** Proper vaccination, good hygiene practices[10]
Scours 	Increases discharge of fluid from bowel, discharge that is white, yellow, grey or bloodstained, or is foul smelling, depression, anorexia, lethargy, loss of condition, dehydration, fever	**T:** Hydration and electrolyte replacement, alterations of the diet, antimicrobial and immunoglobulin therapy, use of antidiarrheal drugs and adsorbents **P:** Ensure adequate colostrum intake, practice good general hygiene, vaccination of pregnant dams, checking and monitoring[7]
Grass Tetany 	Galloping in blind frenzy, falling, bellowing, severe convulsions, death	**T:** Slow IV of calcium and magnesium, then moved off tetany-prone pasture, provide animals with hay treated with 2 oz. of Mg oxide daily **P:** Provide Mg supplement, be cautious when placing cows on lush grass pastures or green cereal crops[6]

Bull Breeding Soundness Evaluation

A breeding soundness evaluation (BSE), performed by a veterinarian, is done to ensure a bull is fertile and that he will be able to successfully breed cows. This evaluation includes physical examination, a scrotal circumference measurement, and semen quality evaluation. In order to pass a breeding soundness evaluation, a bull must have at least 30% sperm motility, and 70% sperm morphology.[13] Motility is generally described as the ability of sperm to swim progressively forward, and is expressed as an estimate of the percentage of sperm that are swimming in a linear fashion within a given environment. Morphology can be defined as any normal sperm shape characteristic. Every ejaculate will contain between 5 and 15% abnormal sperm; these levels are generally considered acceptable. Reduced fertility may be the result when morphologically abnormal sperm exceed 20% of sperm in the ejaculate. It is possible for sperm to have head, tail, or head and tail abnormalities such as coiled tail, folded tail, detached head, tapered heads, crater defect, or ruffled acrosome, etc.[4] The picture below, to the left (excluding letter P), shows some possible abnormalities that can be found in ejaculate. The picture below, to the right, and letter P on the picture to the left shows what a normal spermatozoon should look like.





Proper Nutrition - BCS

Before going into depth about nutrition requirements during the spring season, it is beneficial to understand what the targeted body condition for a cow is. This is measured using the body condition scoring (BCS) system. BCS measures relative fatness and serves as a management tool to determine the nutritional needs of a cow. Guidelines for BCS can be followed to also maximize cow efficiency throughout the year. The key areas for evaluation include the

backbone, ribs, pins, hooks, tail head, and brisket. One body condition score is equivalent to about 80 pounds.

The following pictures will give an idea of what each BCS looks like (scale of 1 to 9):

Body Condition Score 1

- Emaciated with muscle atrophy
- No detectable fat
- Tail head and ribs project predominantly

Body Condition Score 2

- Poor condition with muscle atrophy
- No detectable fat
- Tail head ribs and ribs prominent

Body Condition Score 3

- Thin condition
- Slight muscle atrophy
- All ribs visible
- Very little detectable fat

Body Condition Score 4

- Borderline condition
- Outline of spine slightly visible
- Outline of 3 to 5 ribs visible
- Some fat over ribs and hips

Body Condition Score 5

- Moderate, good overall appearance
- Outline of spine no longer visible
- Outline of 1-2 ribs visible
- Fat over hips but still visible

Body Condition Score 6

- High moderate condition
- Ribs and spine no longer visible
- Pressure applied to feel bone structure
- Some fat in brisket and flanks

Body Condition Score 7

- Smooth, fleshy appearance
- Hips slightly visible
- Ribs and spine not visible
- Fat in brisket and flanks
- Slight udder and tail head fat

Body Condition Score 8

- Fat, fleshy, over-conditioned
- Square appearance
- Bone structure not visible
- Large patchy fat deposits over ribs, around tail head and brisket

Body Condition Score 9

- Extremely fat
- Mobility possibly impaired
- Bone structure not visible
- Extreme fat deposits over ribs, around tail head and brisket

The following table will address some problems associated with a cow that is too thin or too fat. The major problem with extreme conditions is that reproductive efficiency will be compromised. If a cow is too obese or too thin, she may not ever experience estrus, may not return to estrus, may not conceive, or may not be able to carry her pregnancy to term. A BCS of 5-7 is preferred prior to calving time as a strategy to help maximize reproductive efficiency. A cow may lose condition after calving and possibly into breeding season. It is important to note, however, that loss in condition after calving can add to the cow's calving interval. This is reflected as delayed estrus and will lead to a later calf the next spring that will most likely weigh less than other calves. A cow may gain condition as weaning approaches and after their calf has been weaned. Weaning time is the best time to add weight and condition to cows, as their nutrient requirements are the lowest at this time.[14]

Thin Condition (BCS 1-4)	**Fat Condition (BCS 8-9)**
Failure to cycle	Costly to maintain
Failure to conceive	Increased dystocia
Increased calving interval	Impaired mobility
Increased days to estrus	Failure to cycle
Decreased calf vigor	Failure to conceive

The following table will serve as an easy tool to determine the BCS of cows:

Characteristic	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Physically weak	Yes	No	No	No	No	No	No	No	No
Muscle atrophy	Yes	Yes	Slight	No	No	No	No	No	no
Outline of spine visible	Yes	Yes	Yes	Slight	No	No	No	No	No
Outline of ribs visible	All	All	All 3	3-5	1-2	0	0	0	0
Fat in brisket/flanks	No	No	No	No	No	Some	Full	Full	X-treme
Hip/pin bones visible	Yes	Yes	Yes	Yes	Yes	Yes	Slight	No	no
Fat udder and patchy fat around tail head	No	No	No	No	No	No	Slight	Yes	Yes[14]

Proper Nutrition – General Cattle Requirements

The highest protein and energy demands for a cow are when she is at late gestation and early lactation (30 days before calving to 70 days after calving); therefore, the spring season is the most important when determining "what and how much" to feed. In the third trimester, nutrient needs are increasing rapidly due to fetal growth. Body condition score should not fall during this

time – it must be maintained. During the postpartum interval, lactation needs by the calf are high and the cow's reproductive system is recovering (preparing for rebreeding). It is estimated that a cow's intake is about 35-50% higher at these times than at other times of the year. In addition, the energy requirements for 2 and 3 year old heifers are higher than the requirements of older cows, and they require more feed. If feeding cows of all ages in the same group, it is important to feed enough to satisfy the animal with the highest requirement.[1]

It should be emphasized that nutrient needs vary depending on frame size and condition of the cow, stage of production and environmental conditions. In order to successfully provide these amounts for your cows, you must know the nutrients your feed provides. It is highly recommended to send forage samples in for nutrient analysis each year. Contact your local county Extension office for assistance with forage analyses and ration balancing.

4 tables concerning nutrient requirements are located at the end of this section. They give more complete requirements for heifers and cows at different stages of gestation and lactation. Please see the "Supplementary Material" chapter for applicable examples concerning the nutrient requirement for cows and calves.

Horse Care

The horses at the Grant-Kohrs Ranch require special care during the spring season. They are vaccinated, shoed or trimmed, geldings have their sheaths cleaned, and all are given a general health evaluation and dental examination. They are also wormed 30 days after the first flies appear for the same reasons cattle are wormed. They are brought into the pastures where visitors can see them around the 1st of May. The following table helps to explain the importance of the vaccinations horses at the Grant-Kohrs Ranch receive.

What Vaccinated For:	Importance to Horses:
West Nile Virus	Transmitted via mosquitoes; symptoms include stumbling, incoordination, weak limbs, partial paralysis, muscle twitching, and possible death
Eastern & Western Sleep Sickness	Transmitted via mosquitoes or other hematophagous insects; symptoms include altered mentation, impaired vision, aimless wandering, head pressing, circling, inability to swallow, irregular ataxic gait, paresis and paralysis, seizures, and death[5]
Rhino-Pneumonitis	Also known as Equine Herpesvirus Infection; transmitted via direct or indirect contact with infectious nasal secretions, aborted fetuses, placentas, or placental fluids; symptoms include serous nasal discharge, cough, pharyngitis, inappetence, secondary bacterial infections, abortion in pregnant mares, neurologic disease, and death
Influenza	Transmitted via inhalation of respiratory secretions;

	symptoms include high fever, serious nasal discharge, submandibular lymphadenopathy, dry cough, depression, anorexia, weakness, and secondary bacterial infection[11]
Tetanus	Transmitted via *C tetani* being introduced into the tissues through wounds, particularly deep puncture wounds that provide a suitable anaerobic environment; symptoms include localized stiffness, muscle spasms, difficulty in prehension and mastication of food, sweating, and mortality averages about 80%[5]
Strangles	Transmitted via fomites and direct contact with infectious exudates; symptoms include fever, nasal discharge, depression, submandibular lymphadenopathy, difficulty swallowing, extended head and neck, and abcessation in certain lymph nodes of the body[11]

Spring Summary Calendar

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2	3	Apr. 4 Scour Guard cows	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	Apr. 24 Start calving	25	26	27	28
29	30	May 1 Horses in	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	1	2
3	4	5	6	7	8	9
10	11	12	13	Jun. 14 End Calving	Jun. 15 Test bulls	16
17	18	19	20	21	22	23
24	25	26	27	28	29	Jun. 30 Vaccinate cows

Note: The spring summary calendar is based off of dates in 2011 and 2012, and is designed to give an estimate of when activities occur at the Grant-Kohrs Ranch. Actual dates from year-to-year vary.

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Summer Season

July - September

Please refer to glossary for select definitions.

Like all times on a ranch, the summer season is just as busy as the others. At the Grant-Kohrs Ranch, it is busy with things like branding, breeding, and checking cows. Please refer to the subsequent sections to read a more in-depth explanation on the duties and responsibilities of the summer season.

Branding

Many years ago, cattle rustling was a huge problem. To solve this problem, people began to use brands to claim ownership of their cattle. These days, brands can be used to identify whose cattle are whose based on the brand and placement of the brand. One's brand is the only legal form of ownership available in Montana, and the specific brand and location of the brand is recorded by the Montana Department of Livestock. Animals cannot be sold unless the correct brand has been identified by a certified brand inspector. The Grant-Kohrs Ranch brand is a lazy "G," hanging "K," located on the left rib. Grant-Kohrs Ranch also owns a "C" on the shoulder and "K" on the hip. Branding calves is important to do during the spring or summer season for identification purposes; however, vaccinating calves at or near branding time is just as important, if not more. Remember to practice safe handling methods at all times when working with cattle. It is difficult to explain the proper branding technique; however, it is

common for people to leave the iron on a calf until the skin is a tannish color, or until it resembles leather. A white color indicates that the branding iron was left on too long, or that the heat was not evenly distributed. The following link can be used as a reference for how to brand and how to wrestle calves: https://www.youtube.com/watch?v=piYSh-jtfiE

Calf Vaccinations

Please refer to the "Storage, Handling, & Administration of Vaccine" section in the Fall Season chapter for general information concerning vaccines and antibiotics. The vaccines discussed below were given in 2013 and 2014 and are subject to change by veterinarian recommendation.

In recent years, the Grant-Kohrs Ranch has administered Vision 8 Somnus and Vista Once SQ to all calves prior to branding time. On years where pinkeye outbreaks are prevalent, Moraxella Bovis Bacterin has been given to not only calves, but also to cows. Moraxella Bovis Bacterin is used for the prevention and control of pinkeye in healthy cattle caused by Moraxella bovis. The following will give an in-depth description of Vision 8 Somnus and Vista Once SQ.

Vision 8 Somnus

Vision 8 Somnus is a 7-way Clostridial and Haemophilus somnus protection for cattle. This is used for the prevention of disease caused by Clostridium chauvoei, septicum, novyi, sordellii, perfringens Types C & D, plus haemolyticum and Haemophilus somnus. These different bacteria can cause diseases such as: blackleg, malignant edema, black disease, enterotoxemia, and red water.[4] The following table will give a more in-depth description of each disease.

Disease/ Causative Agent	Pathogenesis	Signs & Symptoms
Blackleg/ Clostridium chauvoei	Enters animal through contaminated feed, bacteria enters rapid proliferation phase, produces toxins, leads to muscle death in animal	Lameness, loss of appetite, rapid breathing, high fever, swelling in hip, shoulder, chest, back, neck, & death
Malignant edema/ Clostridium septicum	Enters animal through contamination of wounds, spores activated, toxins cause local and systemic signs, leads to inflammation which causes edema, necrosis, & gangrene	Anorexia, intoxication, high fever, soft swellings, severe edema of affected area, & death
Infectious Necrotic Hepatitis/ Clostridium novyi	Enters animal through fecal contamination from carrier animal, organism multiplies in area of liver necrosis caused by migration of liver flukes, & produces powerful toxin	Isolation, sternal recumbency, & acute death

Enterotoxemia/ Clostridium perfringens Types C & D	Ingestion causes severe enteritis, dysentery, and toxemia, B & C produce necrotizing toxin that damages intestine and is associate with inhibition of proteolysis in intestine	Acute diarrhea, dysentery, abdominal pain, convulsions, opisthotonos, & death
Bacillary Hemoglobinuria/ Clostridium haemolyticum	Enters animal through ingestion of latent spores that become lodged in liver, spores germinate, toxin produced, leads to intravascular hemolysis	Severe depression, fever, abdominal pain, dyspnea, dysentery, red urine, anemia, jaundice, edema of brisket, & death[10]
Histophilosis/ Histophilus somni	Bacterial septicemia, bacteria evade host defenses and causes apoptosis of epithelial cells, causes vasculitis and thrombosis, leads to neutrophil infiltration and tissue necrosis in brain and myocarditis with multiple infarcts, necrosis and abscessation in the heart	Sudden death, depression, rapid respiration, stiffness, muscle weakness, ataxia, lameness, and severe behavioral changes[11]

Vista Once SQ

Vista Once SQ aids in the prevention of respiratory disease caused by infectious bovine rhinotracheitis (IBR) virus, bovine virus diarrhea (BVD) virus (Type 2), and bovine respiratory syncytial virus (BRSV). It also aids in the control of disease caused by BVD virus (Type 1), parainfluenza-3 virus (PI-3), Mannheimia haemolytica, and Pasteurella multocida.[5] Each of these viruses or bacteria has the potential to cause viral respiratory tract infections in cattle. The following table will give further insight about each agent.

Virus/Bacteria	**Importance to Calves**
Infectious Bovine Rhinotracheitis	Virus can be associated with Bovine Herpesvirus 1, can cause bacterial pneumonia
Bovine Viral Diarrhea (Type 1 & 2)	Virus capable of inducing immunosuppression, which allows for development of secondary bacterial pneumonia
Bovine Respiratory Syncytial Virus (BRSV)	Component of bovine respiratory disease, replicates in respiratory tract and causes secondary bacterial pneumonia, disease itself is characterized by watery to thick mucus discharge from nose and eyes, fever, increased breathing rates, dry cough, dehydration, and possible death

Parainfluenza-3 (PI-3)	Important component of enzootic pneumonia and bovine respiratory disease complex, disease itself is usually mild consisting of fever, nasal discharge, and dry cough
Mannheimia haemolytica	Bacterial cause of bacterial pneumonia, significant component of enzootic pneumonia in calves, gains access to lungs when host defenses are compromised by stress or infection with respiratory viruses or mycoplasma
Pasteurella multocida	Bacterial cause of bacterial pneumonia, P. multocida pneumonia associated with environmental and stress factors such as shipping, co-mingling, overcrowding, and concurrent or predisposing viral or bacterial infections[15]

Cow & Bull Management

During the summer months, cows at the Grant-Kohrs Ranch are given Vista 3 VL5 SQ and are wormed with Dectomax. This occurs shortly before the calves at the GRKO Ranch are branded, in late June to early July. Like with the calves, in the case of a pinkeye breakout, Moraxella Bovis Bacterin has been given. The following will give an explanation about each vaccine administered. It is important to remember to contact the local veterinarian with any questions.

Vaccine	Time Administered	Use
Vista 3 VL5 SQ 	Late June/ Early July	Used prior to breeding, as an aid in the control of abortions caused by IBR, BVD Types 1 and 2, an aid in control of respiratory disease caused by IBR, BVD Types 1 and 2, PI3 and BRSV, an aid in reducing infertility caused by Campylobacter fetus (Vibrio), and L. borgpetersenii serovar hardjo-bovis, and an aid in prevention of urinary shedding of L. hardjo organisms[6]
Dectomax 	Late June/ Early July	Treats and controls wide range of roundworms and arthropod parasites which can impair health and productivity of cattle. This may include: gastrointestinal roundworms, lungworms, eyeworms, grubs, biting and sucking lice, horn flies, and mange mites[19]

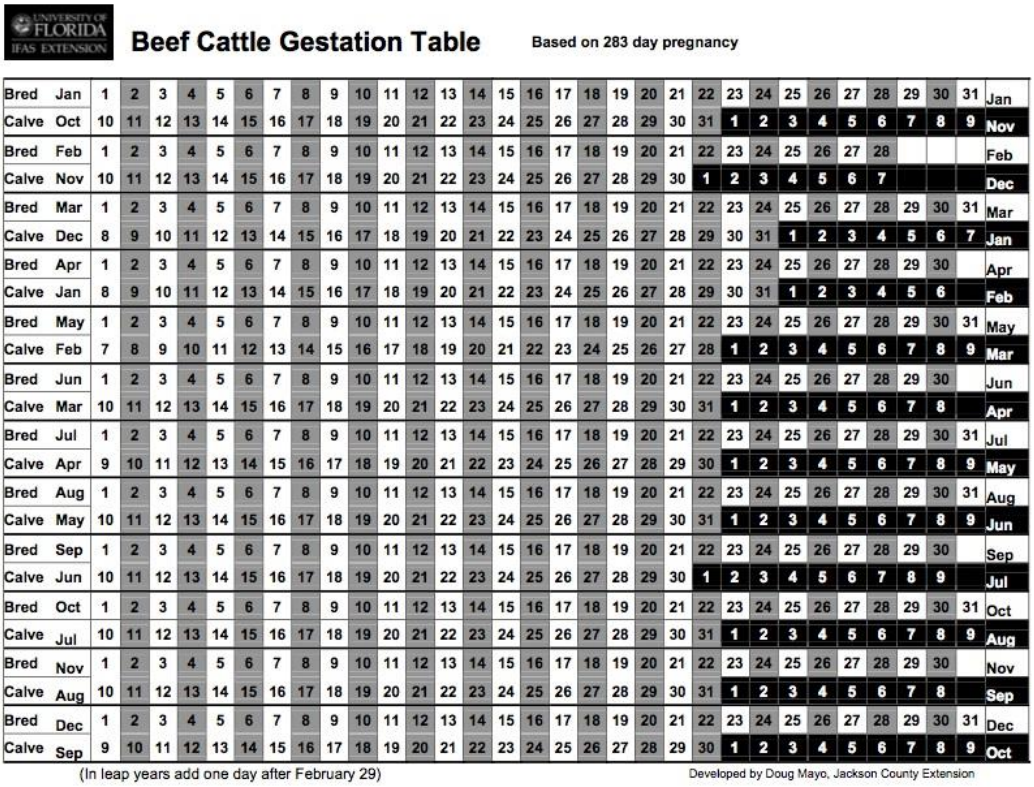
Like the cows at the Grant-Kohrs Ranch, the bulls are also wormed. They receive pour-on once a year to relieve irritation caused by pests. On years where pinkeye is prevalent, they are given fly tags and are vaccinated. This is also done to decrease irritation and to maintain good animal

health. Bulls will do better in the summer if they are comfortable, and can focus their energy on maintaining body condition and breeding cows. Consult the local veterinarian for bull herd health recommendations.

Breeding Season

The average gestation of a cow is approximately 283 days. Ranchers decide when to put bulls with their cows according to that gestation length. At the GRKO Ranch, cows typically calve from about the first of May to the middle of June. The main reasons for this include warmer temperature, abundance of grass, and visitor schedules. If May – June is the targeted time of calving, bulls should be put with cows around July 23rd and taken out around September 5th. This will lead to calves being close to the same age, which can prove to be beneficial for many reasons. When calves are close to the same age, human labor and potential calf health problems can be reduced. Furthermore, this will lead to more consistent weights of calves to be marketed. This could prove to be more attractive to potential buyers. Ranchers manage their herds so that they can focus more attention on their cows when they are calving. Remember that it takes 40 to 60 days for a beef cow to return to estrus after having a calf. This is referred to as the postpartum interval. Maintaining this interval will help ensure a cow will have a calf each year. Body condition score greatly influences the postpartum interval.[2]

The length of a cow's estrous cycle is approximately 21 days long and ranges from 17-24 days. Therefore, if a cow shows heat on the 2nd of July, she will most likely again be showing heat around the 23rd of July, assuming she was not bred. Heat, also known as estrus, lasts for about 15 hours with ovulation occurring 24-32 hours after the onset of estrus. Signs that a cow is approaching estrus include increased locomotion, phonation, nervousness and attempts to mount other animals; however, she will not accept the male for mating. The willingness to mate is referred to as standing estrus. Standing behavior is easily observed and is used as a tool to identify the appropriate time to artificially inseminate a female. Standing behavior is typically observed after many attempted mounts by other cows.[9] The process of artificial insemination will be discussed in the subsequent paragraph. According to several studies, approximately 64% of a herd should become pregnant within the first 21 days of the breeding season, with approximately 89% of the herd becoming pregnant after the first 42 days. These percentages can be used to make sure one's operation is on track. If more than 50 percent of cows are showing heat after the first 21 days of the season, there could be a problem relating to bull or cow fertility, nutrition, or disease, etc. that needs to be addressed.[8]



Beef Cattle Gestation Table Based on 283 day pregnancy

Bred	Jan	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Jan
Calve	Oct	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	Nov
Bred	Feb	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28				Feb
Calve	Nov	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7				Dec
Bred	Mar	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Mar
Calve	Dec	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	Jan
Bred	Apr	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		Apr
Calve	Jan	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6		Feb
Bred	May	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	May
Calve	Feb	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	1	2	3	4	5	6	7	8	9	Mar
Bred	Jun	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		Jun
Calve	Mar	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8		Apr
Bred	Jul	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Jul
Calve	Apr	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	May
Bred	Aug	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Aug
Calve	May	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	Jun
Bred	Sep	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		Sep
Calve	Jun	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9		Jul
Bred	Oct	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Oct
Calve	Jul	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	Aug
Bred	Nov	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		Nov
Calve	Aug	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8		Sep
Bred	Dec	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Dec
Calve	Sep	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	Oct

(In leap years add one day after February 29)

Developed by Doug Mayo, Jackson County Extension

Bull Selection

Bull selection always proves to be very important. Ranches should outline general and specific guidelines when determining which bulls to purchase and use. The Grant-Kohrs Ranch always aims to purchase virgin bulls that are less than 18 months of age (yearlings). Virgin bulls are purchased to decrease the chance of acquiring a disease like trichomoniasis that can be transmitted to cows. Infertility due to embryonic death and a "nonpregnant abnormal" reproductive tract may be some of the signs seen in cows that acquire trichomoniasis. Furthermore, the Grant-Kohrs Ranch seeks bulls that have heavy muscling, good conformation, and possess a calm disposition. Any undesired quality that is seen in a bull can be inherited by the offspring. Heavy muscling will improve meat quality for the consumer. Having a bull that is structurally correct will decrease the likelihood of feet and leg problems, and they will also most likely be able to service a larger number of cows for a longer period of time. As a general rule, 1 bull should be able to service 20 cows (1bull:20cow ratio). A calm disposition should also be made priority for all producers. Having animals with calm dispositions will decrease the chance of harm being done to employees or visitors by dangerous animals. This trait is heritable and can be easily controlled by selecting for bulls that are docile.

Within the past few decades, technologies such as artificial insemination and embryo transfer have become popular when breeding cows, and when trying to select superior bulls. Although neither technology is currently used at the Grant-Kohrs Ranch, AI especially, may be used in the future. Some advantages of AI include the ability to use sires of superior genetic merit without having to purchase the actual bull, improving production traits, ability to mate specific sires to individual cows, reducing number of herd bulls needed, increased genetics for replacement heifers, and when combined with estrous synchronization, a shorter calving season can be achieved, resulting in a more uniform calf crop. By using AI, bulls can be chosen based on their EPDs (expected progeny differences), their physical characteristics, and an individual ranch's breeding objectives. Most producers target a few major objectives when choosing a bull to be used on their cows. This list includes some of the following, but is not limited to:

1) Calving ease
    - Ranchers want a bull with a high calving ease so that their cows will be more likely to have a calf on their own.
2) Low birth weight
    - If a calf has a low birth weight, the cow will be more likely to calve without complications or needed assistance from appropriate personnel.
    - Most bulls that are used on cows should not be used on heifers. Because heifers have not had a calf and are smaller, it is important the bull used throws low birth weight calves.
3) High weaning and yearling weights
    - Growth qualities are important to most people. Producers are mainly paid by the pound, so it is important to have adequate weight gains.

Expected Progeny Difference (EPD)

As stated earlier, EPDs can be and are used by the Grant-Kohrs Ranch when selecting bulls to be used on cows and heifers. EPDs measure the expected differences in performance of a sire's progeny when compared to the average progeny of all sires evaluated within the same breed. Using EPDs are beneficial as they can be used to compare animals in terms of genetic merit, estimate the expected difference in progeny due to genetics when comparing animals, and to increase, decrease, or maintain a certain trait. EPDs cannot be used to compare bulls of different breeds, as breed averages are not the same among all breeds; thus, Herefords, Shorthorns, and Longhorns cannot be directly compared. A bull can either be referred to as a young or proven

sire depending on the number of progeny the bull has sired. A proven sire has sired more progeny, and therefore possesses EPDs with higher accuracy. The accuracy values (ACC) range from 0.00 – 1.00, with 1 being the highest possible reliability.[16] The following data for the Hereford bull, HH Advance 0132X, can be referenced when learning about interpreting EPDs. Note that the accuracy values differ between traits due to the number of progeny records documented (i.e. more records concerning BW than MILK).

TRAIT	CED	BW	WW	YW	MILK	M+G	CETM	SC	FAT	REA	IMF	$BMI	$CEZ	$BII	$CHB
EPD	3.8	0.7	49	69	27	51	2.6	1.30	0.043	-0.15	0.23	23	19	20	22
ACC	.31	.79	.64	.64	.18		.25	.48	.43	.43	.40				

Trait	Abbreviation	About the EPD
Calving Ease Direct	CED	CED is the ability of a sire's calves to be born and is expressed as percentage of unassisted births; therefore, higher CED numbers indicate greater calving ease.
Birth Weight	BW	BW measures the weight of the sire's progeny within the first 24 hours of life, and compares the progeny's BW to the breed average. Lower BW numbers (can be negative numbers) are favored.
Weaning Weight	WW	WW predicts a sire's ability to transmit weaning growth to his progeny, where a greater number is favored.
Yearling Weight	YW	YW predicts the difference in average 365 day weight of a bull's progeny, where a higher number is favored.
Maternal Milk	MILK	MILK is a predictor of a sire's genetic merit for milk and mothering ability. It is expressed in pounds of calf produced attributed to milk and mothering ability.
Maternal Milk & Growth	M+G	M+G measures a sire's ability to transmit milk production and growth rate through his daughters (Milk EPD + ½ WW EPD).

Calving Ease Total Maternal	CETM	CETM measures the ease with which a sire's daughters will calve as first-calf heifers. A higher CETM value indicates greater calving ease.
Scrotal Circumference	SC	SC, expressed in centimeters, is the distance around the testicles in the scrotum. SC is related to semen producing capacity and age at puberty of female siblings and progeny
Backfat	FAT	FAT is the adjusted 12th rib fat thickness of a sire's progeny and is expressed in inches.
Ribeye Area	REA	REA is the adjusted ribeye area of a sire's progeny. REA is found by finding the area of the longissimus dorsi located between the 12th and 13th ribs.
Marbling	IMF	IMF is expressed as a fraction of the difference in USDA marbling score of a sire's progeny compared to progeny of other sires.[14]

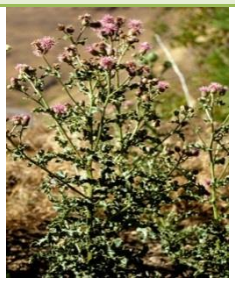
Summer Pasture Nutrition

After cows have calved, they should be moved to a summer grazing pasture. This pasture should provide the cows and calves with the appropriate amount of forage and nutrients to at least maintain body condition.[1] The pasture should not be over-utilized and it may be necessary to move the cattle several times during the summer. This is of course dependent upon stocking rate and the climate of the particular summer. This will maximize health and growth of the cattle and the land. The Grant-Kohrs Ranch maintains a stocking rate of approximately 100 AUs or 1200 AUMs/acre. AUM stands for "animal unit month" and is the amount of forage needed by an animal unit grazing for one month. An animal unit is standardly known as a 1000 pound cow of average milking ability with a calf less than four months old. Stocking rate formulas can be easily manipulated to find values such as number of grazing animals, number of acres, forage biomass, time, use, and rate of use. It is important to recognize if adequate levels of needed minerals and vitamins are being reached. More importantly, it is common that cattle may not receive enough minerals and vitamins needed for high levels of production, and must be supplemented.

Please see the last chapter, "Supplementary Material," for applicable examples concerning the nutrient requirement for cows and calves.

Noxious or Deadly Weeds

Weeds can become out of control if given the right opportunity. It is important to always especially control noxious weeds and weeds that can be deadly to livestock and horses. The following table explains the potential harm some noxious and deadly weeds found in Western Montana can have on a ranch. Contact your extension agent or veterinarian with any questions.

Weed Common Name	Tools to Identify
Houndstongue ➢ Noxious ➢ Potentially deadly to livestock[7]	 
Canada thistle ➢ Noxious weed of Montana ➢ Nitrate accumulator	 
Poison hemlock ➢ Deadly to livestock and humans[17]	 
Death camas ➢ Deadly to livestock and humans[18]	 

Larkspur ➢ Deadly to cattle, rarely affect sheep or horses[18]	 
Lupine ➢ Deadly to livestock[18]	 

Cow & Calf Management

Although cows and calves are fairly low maintenance after they have been sent out to summer pasture, it is still important to understand that they need to be checked frequently. At the Grant-Kohrs Ranch, cows and calves and water should be checked daily and findings recorded in the Daily Herd Check record. When checking, special attention should be given to all animals, as well as the resources they are using (grass and water). Refer to "Water Requirements" located at the end of the document for specifics on water quality. As a producer, being a good steward to the land is of utmost importance, so one needs to pay special attention to natural resources throughout all times of the year. The following table will give examples of some sicknesses that may be seen in cows and calves during the summer.

Cows & Calves		
Sickness/Disease	**Clinical Signs & Symptoms**	**Treatment & Prevention**
Diphtheria (oral form) 	Swollen cheek, high temperature, coughing, anorexia, depression, difficulty breathing, chewing, swallowing, swollen pharyngeal region, deep ulcers in mouth, pneumonia	**T:** Antimicrobials, other various drugs to reduce swelling or fever, recommendation from local veterinarian **P:** Decrease dust prevalence, reduce stress
Diphtheria (laryngeal form)	Coughing, high temperature, loss of appetite, depression, difficult breathing, chewing, and swallowing, pneumonia	**T:** Antimicrobials, other various drugs to reduce swelling or fever, recommendation from local veterinarian

		**P:** Decrease dust prevalence, reduce stress[15]
Footrot 	Fever, anorexia, lameness, redness of interdigital tissue, swelling of foot, spreading of toes	**T:** Antibiotics, recommendation from local veterinarian **P:** Introduce proper drainage, don't purchase lame animals, isolate sick animals[13]
Pinkeye 	Photophobia, mucopurulent ocular discharge, conjunctivitis, one or more small ulcers near center of cornea, corneal opacity	**T:** Long acting oxytetracycline and tulathromycin, & other antibiotics, bulbar conjuntival injection with penicillin **P:** Good management practices, separate infected animals, use dust bags or insecticide-impregnated ear tags to reduce number of face flies, M bovis bacterins[12]

It is vital to always contact your local veterinarian with any questions concerning the treatment of sick animals. It is also important to always follow label instructions when administering a drug.

When checking cows and calves for sickness and when determining what is wrong, it is beneficial to know healthy bovine vital signs. The following table gives the vital signs of a healthy cow. The use of this chart is not mandatory, but can be used as a reference if needed. A healthy calf typically possesses values that are slightly higher than those of a healthy cow.

Vital Sign	**Normal Range**
Rectal Temperature (°F) - Taken rectally	98.0-102.4
Resting Heart Rate (bpm) - Can be felt under tail	48-84
Resting Respiratory Rate (breaths/min) - Rise and fall of ribs	26-50[14]

Parasite Control & Prevention

When addressing parasite control and prevention, it important to note that the overall objective is to stop irritation and promote animal health and well-being. The summer season tends to be associated with an increase in the amount of pests and parasites that need to be controlled. Many of these parasites can easily build resistance to treatments being used, so it is important to have a proper pest management plan in place. At the Grant-Kohrs Ranch, products like Dectomax are used throughout the year. It should be known that there is a fairly high potential for flies to build resistance to one particular insecticide. Keep reading to learn more about building resistance and for a possible recommendation the GRKO Ranch could use. Pests and parasites can have many effects on animal health including: blood loss, dermatitis, allergic responses, self-wounding, social nuisance, myiasis, envenomation, annoyance, and weight loss. Annual losses throughout the entire United States from some pests can be greater than 1 billion dollars in severe cases.[3]

Types of prevention and control methods include:

Mechanical:

- Physically remove pests
- Practice proper sanitation methods
- Pasture rotation

Biological:

- Wasp parasites
- Egg, larvae, and pupae predators (i.e. dung beetles)
- Competitors for same food source

Chemical**:**

- Pour-on
- Ear tags
- Dust bags
- Oilers

The treatments used for these chemical control mechanisms can vary greatly. It is best to contact your local veterinarian or entomologist for further information. The following table lists some arthropods and arachnids that can cause harm to livestock.

Arthropod/ Arachnid	Veterinary Importance	Treatment/ Control
Horse & Deer flies (Tabanids) 	Painful and persistent biters, cause reduced weight gains, reduced milk yields, lowered feed efficiency, and loss of blood, potential vector of anthrax, tularemia, & anaplasmosis	Short-term control with insecticides, move animals, provide shelter for protection, water management, & traps
Horn flies 	Produced in fresh manure, adult flies spend 95% of time on adult animal, painful biters, most common summertime pest on pastured cattle, cause reduced weight gains & reduced milk yields	Introduce wasp parasites, or other predators such as dung beetles, direct application of avermectin/pyrethroid/spinosad via sprays and pour-ons, self-application via dust bags or oilers, sustained release via mineral supplements, insecticide ear tags
Face flies 	Produced in fresh manure, general annoyance to cattle, damage eye tissue, vector of pinkeye and eyeworm	Insecticide ear tags, dust bags, oilers, feed additives and boluses, sprays/pour-on
House flies 	Produced in organic material, garbage, feces, common in confined area, vector of bovine mastitis bacteria, enteric bacteria, and food-borne bacteria, feed on animal body fluids	Eliminate egg-laying sites, spread material out to dry, traps, sprays, fly bait
Stable flies 	Produced in mixture of organic material (feed, manure, soil) and moisture (water, urine), common in confined area, cause annoyance to animals, reduced feed efficiency and weight gains, & reduce milk yield, vector of anthrax, harbor lumpy skin disease virus & bovine leukosis pathogen	Insecticides moderately effective

Cattle grubs (heel flies) 	Cause reduced weight gains, lower milk production, increased carcass trim loss, damage to hides, and injury from gadding	Systemic pour-ons
Biting & sucking lice 	Cause irritation to cattle, hair loss, damage to hide, damage to livestock facilities, affect overall vitality of host, decrease weight gains	High energy diets to avoid stress, identify and cull carrier animals, insecticides (dust bags, backrubbers, pour-ons, injections, ear tags), best treatment time is in fall/early winter
Biting midges 	Cattle can be reservoir of Bluetongue Virus (transmitted via biting midges), 1-2% of cattle in MT test seropositive, restricted trade to bluetongue-free countries	Pour-ons, insecticide ear tags
Ticks 	Can cause dermatitis, envenomtion, anemia, tick paralysis, vector of many diseases (i.e. Cattle tick fever, Anaplasmosis, Tick paralysis, Borrelisoses	Some pour-ons[3]

Recommendation:

Arthropod resistance is getting to be more and more common. The primary reason for this is genetic selection due to an evolutionary process. The high degree of selective pressure which insecticides place on arthropod populations has resulted in many cases of resistance. It can be beneficial to think of resistance in terms of "survival of the fittest." For example, if a rancher uses a product such as Dectomax, a large majority of horn flies will indeed die; however, some flies will not die because they are already resistant to that particular insecticide. They are therefore the ones that remain and are left to reproduce, producing flies that are also resistant to Dectomax. Because annoyance and irritation from arthropods can be severe and can lead to huge

losses, it is important that a proper parasite control and prevention protocol is active. The following protocol is a solely a suggestion that can be used for horn fly control during the summer. It has been used by many people and no sign of resistance has been seen. Specific to the Grant-Kohrs Ranch, it would work best to put fly tags in all cows at the same time Vista 3 is administered. Horn flies spend 90% of their time on adult animals, so do not spend time or money giving fly tags to calves. If flies are abundant on the cows when it's time to tag, it's best to use a pyrethroid pour-on first. Some examples of pyrethroid pour-on include Saber, Ultra Boss, and Synergized DeLice, etc. The pour-on and fly tags can be given the same day. Always consult your local veterinarian for suggestions each year.

Year	**Fly Tag**	**Controls:**
Year 1	XP 820™	Horn flies, Gulf Coast ticks, spinose ear ticks
Year 2	WARRIOR™	Horn flies, biting lice, sucking lice, Gulf Coast ticks, spinose ear ticks
OR		
Year 2	OPtimizer®	Horn flies, biting lice, Gulf Coast ticks, spinose ear ticks
Year 3	PYthon® Magnum™	Horn flies, biting lice
OR		
Year 3	PYthon®	Horn flies, face flies, biting lice, Gulf Coast ticks, spinose ear ticks

Summer Summary Calendar

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Jul. 1 Vaccinate calves	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	Jul. 23 Brand calves	24	Jul. 25 Bulls in	26	27	28
29	30	31	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	1	2
3	4	5	Sep. 6 Bulls out	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

Note: The summer summary calendar is based off of dates in 2011 and 2012, and is designed to give an estimate of when activities occur at the Grant-Kohrs Ranch. Actual dates from year-to-year vary.

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Fall Season

October - December

Please refer to glossary for select definitions.

For ranchers, one of the main activities in the fall is weaning. When calves are weaned, certain measures are taken to ensure that all cows and calves will remain healthy. It has proven to be extremely beneficial for calves to be vaccinated prior to weaning (preconditioned). The following sections will provide an in-depth discussion concerning not only weaning, but also other activities that are of importance in the fall.

Definition of Preconditioning

Many producers define preconditioning as a vaccination, nutritional, and management program designed to prepare young cattle to best withstand the stresses of adjustment when they leave their point of origin and enter the channels of trade. This is true; it is done to prevent diseases that can become prevalent after the calf has been stressed. This is important, as treatment regimes, labor, and death are not desirable. A list of advantages concerning preconditioning calves may include factors like:

1) Stress and health problems are greatly reduced
2) Reduced potential medical costs
3) Higher weight gains
4) Value is added to the calves, as demand will be higher

At the Grant-Kohrs Ranch, preconditioning is typically done around the middle of November, when calves are about 6 months old. The vaccination protocol has in the past included giving Vision 8 Somnus and Vista Once SQ at preconditioning time, followed by a booster of Vision 8 Somnus at weaning. Yearly vaccinations given are recommended by a veterinarian and are

subject to change. The "Vaccinations Given at Preconditioning" section will provide information concerning each vaccine given to calves at preconditioning. Please contact the local veterinarian with any questions.

Definition of Weaning

Weaning is the process of separating calves from their mothers. Calves can be weaned any time after their rumens become functional and their digestive system can process whole feeds. For the cow, weaning helps maintain reproductive efficiency, health, etc. When a cow doesn't have a calf, she has time to conserve energy to allow for development of the new calf inside her. The time of weaning varies widely – forage resources, cow body condition, sale time, and other ranch activities can all influence the time of weaning. On average, calves are weaned between 3 and 8 months of age. At the Grant-Kohrs Ranch, they are approximately 7 months old. As stated earlier, the calves are given a Vision 8 Somnus booster shot or similar product at weaning and are also poured on with Dectomax. The "Vaccinations Given at Weaning" section will provide information concerning the Vision 8 Somnus booster and Dectomax. It has proven to be beneficial to wean calves at least 45 days prior to shipping time. The 30-45 days post-weaning can be a very stressful time for calves, so it is important to allow this time so that their immune systems can recover, and so that they are used to eating from a bunk, etc.

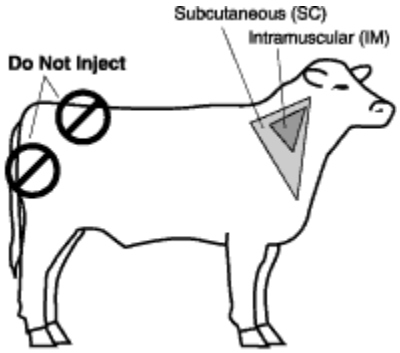
Storage, Handling, Administration, & Documentation of Vaccine

Vaccines are used as a management tool to reduce and prevent potential disease in your herd, but much of their effectiveness depends upon proper usage. Vaccines work by stimulating an animal's immune system to produce a protective response against an organism. The immune system will then remember how to produce a response if ever infected with a particular organism. Vaccinating your animals cannot reduce exposure to certain organisms, but it does increase the animal's ability to fight off an infection or lessen the severity of a disease. Because of this, proper usage is of utmost importance. Vaccines and antibiotics must always be stored, handled, and administered correctly. The best way to ensure this is being done is to always read and follow label directions. If any questions arise, contact your local veterinarian. The following table will give some "do's and don'ts" of proper vaccine and antibiotic usage.

DO	DO NOT
Read label directions carefully	Assume you know all the information already
Store vaccines that need to be refrigerated in the refrigerator (35 to 45 degrees Fahrenheit)	Leave vaccines in direct sunlight or allow them to freeze
Store specified antibiotics at room temperature	Expose antibiotics to extremes (heat, cold, light, etc.)
Transport vaccines properly with ice pack, etc.	Let your vaccine or antibiotic be susceptible to

	extremes
Discard expired vaccine or antibiotics	Use expired vaccine or antibiotics
Use clean needles	Use dull or used needles
Wash guns and syringes with hot water and sterilize with boiling water after use	Wash guns with disinfectant of any sort (gel, soap, etc.)
Properly mix modified live vaccines and discard remainder after use as efficacy is short *(see below for step-by-step instruction)*	Mix different vaccines or other injectable drugs together into one syringe
Abide by withdrawal date	Be untruthful and sell animals in withdrawal period
Dispose of needles in special sharps container	Drop & leave needles on the ground or other hazardous place

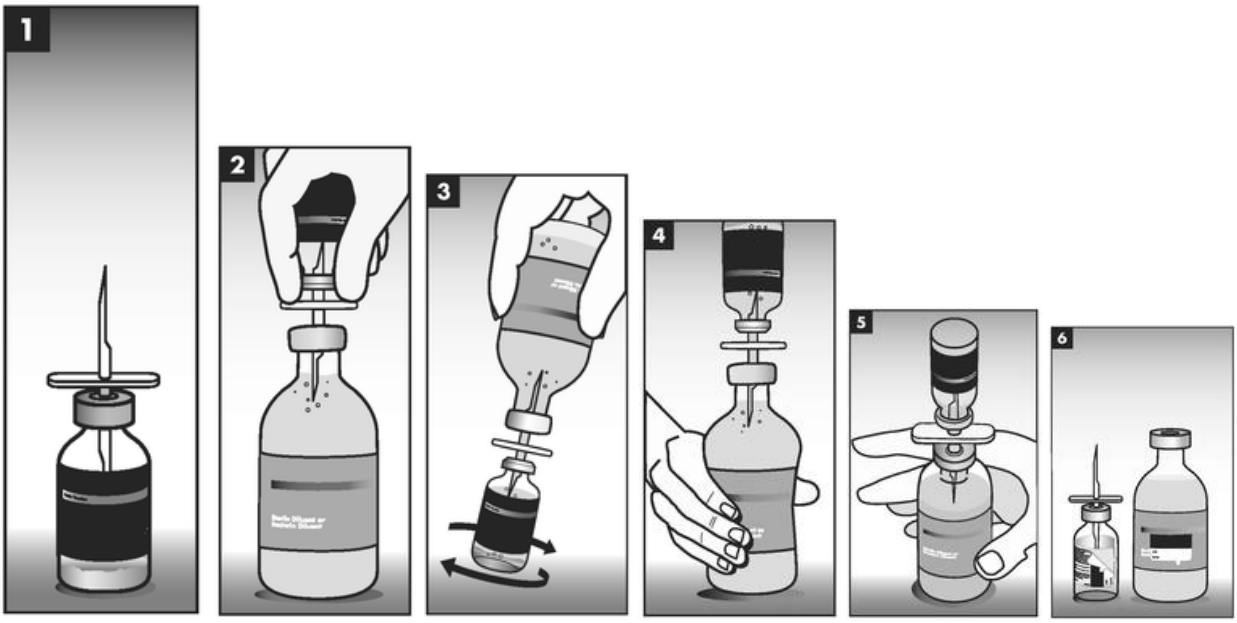
Proper storing and handling of vaccines and antibiotics is extremely important regarding effectiveness; however, proper administration is important as well. The only acceptable site for injection is in the neck. This is done subcutaneously (SC, under the skin) or intramuscularly (IM, in the muscle). The following diagram shows proper sites for injection. Injection in other places can and will cause blemishes in the meat that will have to be wasted. Although blemishes can be present in the neck, cuts found in the neck are lower-value and it isn't such a loss if they need to be trimmed.



As stated earlier, producers need to and must abide by the specified withdrawal date of each vaccine or antibiotic that is used. Withdrawal periods reflect the amount of time necessary for an animal to metabolize an administered product and the amount of time necessary for the product concentration level in the tissues to decrease to a safe, acceptable level. After the withdrawal period, animals can be slaughtered as the meat is safe to consumers. The following table gives the specific withdrawal periods of each product administered to cows and calves during this time period.[12]

Product Administered	Withdrawal Period
Vision 8 Somnus (Calves)	21 days
Vista Once SQ (Calves)	21 days
Vira Shield 6 + L5 HB (Cows)	60 days
Dectomax (Cows & Calves)	45 days

Because Vista Once SQ is used and is a modified live vaccine (MLV), it may of assistance to look at the following diagrams to understand how to properly mix a MLV.



Vaccinations Given at Preconditioning

Vaccines discussed below were given in 2013 and 2014 and are subject to change by veterinarian recommendation.

Vision 8 Somnus

Vision 8 Somnus, given subcutaneously, is a 7-way Clostridial and Haemophilus somnus protection for cattle. This is used for the prevention of disease caused by Clostridium chauvoei, septicum, novyi, sordellii, perfringens Types C & D, plus haemolyticum and Haemophilus somnus. These different bacteria can cause diseases such as: blackleg, malignant edema, black disease, enterotoxemia, and red water.[3] The following table will give a more in-depth description of each disease. Clostridial diseases are extremely fast-acting; in fact, the most common symptom of clostridial diseases is death. Thus, vaccination for these strains in order to provide the animal immunity is critical. Furthermore, the administration of Vision 8 Somnus given at preconditioning is considered a booster and is necessary for the effectiveness of the vaccine.

Disease/ Causative Agent	Pathogenesis	Signs & Symptoms
Blackleg/ Clostridium chauvoei	Enters animal through contaminated feed, bacteria enters rapid proliferation phase, produces toxins, leads to muscle death in animal	Lameness, loss of appetite, rapid breathing, high fever, swelling in hip, shoulder, chest, back, neck, & death
Malignant edema/ Clostridium septicum	Enters animal through contamination of wounds, spores activated, toxins cause local and systemic signs, leads to inflammation which causes edema, necrosis, & gangrene	Anorexia, intoxication, high fever, soft swellings, severe edema of affected area, & death
Infectious Necrotic Hepatitis/ Clostridium novyi	Enters animal through fecal contamination from carrier animal, organism multiplies in area of liver necrosis caused by migration of liver flukes, & produces powerful toxin	Isolation, sternal recumbency, & acute death
Enterotoxemia/ Clostridium perfringens Types C & D	Ingestion causes severe enteritis, dysentery, and toxemia, B & C produce necrotizing toxin that damages intestine and is associate with inhibition of proteolysis in intestine	Acute diarrhea, dysentery, abdominal pain, convulsions, opisthotonos, & death
Bacillary Hemoglobinuria/ Clostridium haemolyticum	Enters animal through ingestion of latent spores that become lodged in liver, spores germinate, toxin produced, leads to intravascular hemolysis	Severe depression, fever, abdominal pain, dyspnea, dysentery, red urine, anemia, jaundice, edema of brisket, & death[9]
Histophilosis/ Histophilus somni	Bacterial septicemia, bacteria evade host defenses and causes apoptosis of epithelial cells, causes vasculitis and thrombosis, leads to neutrophil infiltration and tissue necrosis in brain and myocarditis with multiple infarcts, necrosis and abscessation in the heart	Sudden death, depression, rapid respiration, stiffness, muscle weakness, ataxia, lameness, and severe behavioral changes

Vista Once SQ

Vista Once SQ, given subcutaneously, aids in the prevention of respiratory disease caused by infectious bovine rhinotracheitis (IBR) virus, bovine virus diarrhea (BVD) virus (Type 2), and bovine respiratory syncytial virus (BRSV). It also aids in the control of disease caused by BVD virus (Type 1), parainfluenza-3 virus (PI-3), Mannheimia haemolytica, and Pasteurella multocida. Each of these viruses or bacteria have the potential to cause viral respiratory tract infections in cattle.[4] Like Vision 8 Somnus, Vista Once SQ is given as a booster shot at preconditioning time and must be given to ensure the efficacy of the vaccine. The following table will give further insight about each agent.

Virus	**Importance to Calves**
Infectious Bovine Rhinotracheitis	Virus can be associated with Bovine Herpesvirus 1, can cause bacterial pneumonia
Bovine Viral Diarrhea (Type 1 & 2)	Virus capable of inducing immunosuppression, which allows for development of secondary bacterial pneumonia
Bovine Respiratory Syncytial Virus (BRSV)	Component of bovine respiratory disease, replicates in respiratory tract and causes secondary bacterial pneumonia, disease itself is characterized by watery to thick mucus discharge from nose and eyes, fever, increased breathing rates, dry cough, dehydration, and possible death
Parainfluenza-3 (PI-3)	Important component of enzootic pneumonia and bovine respiratory disease complex, disease itself is usually mild consisting of fever, nasal discharge, and dry cough
Mannheimia haemolytica	Bacterial cause of bacterial pneumonia, significant component of enzootic pneumonia in calves, gains access to lungs when host defenses are compromised by stress or infection with respiratory viruses or mycoplasma
Pasteurella multocida	Bacterial cause of bacterial pneumonia, P. multocida pneumonia associated with environmental and stress factors such as shipping, co-mingling, overcrowding, and concurrent or predisposing viral or bacterial infections[11]

<u>Vaccinations & Treatments Given at Weaning</u>

Vaccines discussed below were given in 2013 and 2014 and are subject to change by veterinarian recommendation.

As stated earlier, a booster of Vision 8 Somnus is given to the calves at the Grant-Kohrs Ranch at weaning time. Some vaccines are required a booster shot for the animal to maintain immunity. Booster shots can be described as "reminders" to the immune system, and must be given at the correct time to maintain efficacy of the product. As a reminder, Vision 8 Somnus is used for the

prevention of disease caused by Clostridium chauvoei, septicum, novyi, sordellii, perfringens Types C & D, plus haemolyticum and Haemophilus somnus. For details about each causative agent, please see the pertinent table under the "Vaccinations Given at Preconditioning" section.

In addition to receiving a booster shot, calves are also poured on with Dectomax. Dectomax treats and controls wide range of roundworms and arthropod parasites which can impair health and productivity of cattle. This may include: gastrointestinal roundworms, lungworms, eyeworms, grubs, biting and sucking lice, horn flies, and mange mites.

Also during this time, heifer calves that are being kept for replacements are Bangs vaccinated. Heifers need to be vaccinated between 4 and 12 months of age.[6] Bangs vaccinating, done by your local veterinarian, protects against Brucellosis (Bang's disease), which is caused by the bacterium, Brucella abortus. Like the bacteria name sounds, Brucellosis in cattle causes abortion in the second half of gestation. Approximately 80% of unvaccinated cows in later gestation will abort if exposed to Brucella abortus. Brucellosis is spread via direct and indirect contact with milk and uterine discharges. It can also be spread by venereal transmission from an infected bull to cow.[8] Vaccinating heifer calves for Brucellosis is particularly important at Grant-Kohrs Ranch because of its close proximity to bison and elk in the area that have the potential to be carriers of Brucellosis.

Cow Vaccinations & Parasite Control

Vaccines discussed below were given in 2013 and 2014 and are subject to change by veterinarian recommendation.

At weaning time in December, cows are vaccinated with Vira Shield 6 + L5 HB and are wormed with Dectomax. Cows are vaccinated at this time to prevent certain diseases that may lead to abortion. The subsequent text will explain what each product is used for and why they are of importance.

Vira Shield 6 + L5 HB

Vira Shield 6 + L5 HB, given subcutaneously, acts as an aid in the prevention of disease caused by infectious bovine rhinotracheitis, bovine virus diarrhea type 1 and 2, parainfluenza type 3, bovine respiratory syncytial viruses, and Leptospira canicola, grippotyphosa, hardjo-bovis, icterohaemorrhagiae, and pomona. Vira Shield 6 + L5 HB is used for healthy cattle, including pregnant cows and heifers, and reduces disease risk to cows and their unborn calves.[5] By vaccinating heifers and cows at this time, we hope that some of the antibodies will later be found in the colostrum for the use of their calf.

Virus	Importance to Pregnant Cows
Infectious Bovine Rhinotracheitis	Major cause of viral abortion in U.S., can recur therefore some cows are possible carriers, virus carried to placenta, causes placentitis, kills fetus
Bovine Viral Diarrhea Type 1 & 2	Most commonly diagnosed virus in bovine abortion cases, may cause abortion, mummification, resorption, developmental abnormalities, or cow may have persistently infected calf if infected before 125 days gestation
Parainfluenza Type 3 (PI-3)	Not a cause of abortion, virus can serve as initiator that can lead to the development of bacterial pneumonia, disease associated with PI-3 usually associated with mild to subclinical infections
Bovine Respiratory Syncytial Virus (BRSV)	Not a cause of abortion, major cause of respiratory disease and contributor to the bovine respiratory disease complex[11]
Leptospira canicola	Cause of Leptospirosis, placentitis causes abortion in last trimester, urine and milk of dams may be infective for up to 3 months
Leptospira grippotyphosa	Cause of Leptospirosis, placentitis causes abortion in last trimester, urine and milk of dams may be infective for up to 3 months
Leptospira hardjo-bovis	Cause of Leptospirosis, host adapted to cattle and can cause lifelong kidney and reproductive tract infections, reduces conception rates in carrier cows and cows bred to carrier bulls, can shed organism in urine for life
Leptospira icterohaemorrhagiae	Cause of Leptospirosis, placentitis causes abortion in last trimester, urine and milk of dams may be infective for up to 3 months
Leptospira pomona	Cause of Leptospirosis, placentitis causes abortion in last trimester, urine and milk of dams may be infective for up to 3 months[10]

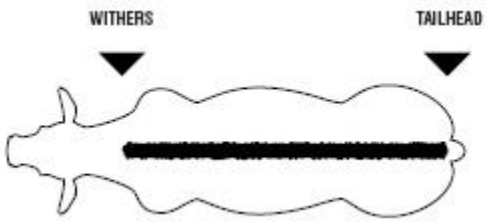
As stated earlier, Dectomax treats and controls a wide range of roundworms and arthropod parasites which can impair health and productivity of cattle. This may include: gastrointestinal roundworms, lungworms, eyeworms, grubs, biting and sucking lice, horn flies, and mange mites. Like with using only Dectomax in the summer, it is possible to see some control issues with only using Dectomax in December for grub and lice control. It is best to rotate products to avoid a potential resistance problem.

Recommendation:

To help ensure control, a yearly product rotation is recommended. The following table gives an example of what a possible plan could look like. By switching products each year, the possibility of parasite resistance should be eliminated. Contact the local veterinarian for specific animal worming and fly control recommendations.

Year	Possible Product to Use	Active Ingredient
Year 1	Dectomax	Doramectin
Year 2	Ivomec	Ivermectin
Year 3	Cydectin	Moxidectin
Year 4	Ivomec Eprinex	Eprinomectin

Where to apply pour-on:



Calf Nutrition Post-Weaning

As stated earlier, the time after a calf is weaned can be a very stressful time. Because of this, it is important that they receive adequate feed to fulfill their nutritional requirements in terms of quality and quantity. Calves at the Grant-Kohrs Ranch are fed grass hay and are supplemented with Crystalyx Brigade immediately following weaning. Grass hay helps to provide calves with the protein and energy they need to grow after being weaned from their mothers. It is important to have adequate energy in the diet as it is used for many different reasons. Energy is used first for maintenance, and then for lactation, growth, pregnancy maintenance, the estrous cycle and initiation of pregnancy, and lastly for excess energy reserves. Protein is needed in the diet to synthesize amino acids. A protein deficiency in growing animals may lead to decreased intake, decreased growth rate, and poor feed efficiency. Grass hay also provides calves with some minerals such as sulfur, phosphorus, potassium, calcium, magnesium, sodium, iron, manganese, copper, and zinc. Minerals are extremely important and are involved in almost every process in the body including immunity, reproduction, growth, and metabolism.[1]

Crystalyx Brigade is formulated specifically for helping calves overcome nutritional stress associated with weaning, shipping, grouping, and the breeding period. It is composed of electrolytes, high levels of vitamins and minerals, and chelated/organic trace minerals. Different

types of minerals are needed in varying amounts to keep the body healthy, and are therefore classified as either macro minerals or trace minerals. Macro minerals are required in larger amounts in the diet than trace minerals. Macro minerals include calcium, magnesium, phosphorus, potassium, chloride and sulfur, and trace minerals include iron, copper, zinc, manganese, fluoride, selenium and cobalt. Because of the varying amounts that are required, deficiencies and toxicities can occur. It is beneficial to know the mineral make-up of feed and water that are being consumed so that that does not happen. Vitamins are organic compounds that are essential in the diet because they are necessary for normal metabolism. Ruminants are likely to be deficient in vitamin A, vitamin D, and vitamin E. Luckily, those vitamins are found in high quality forage and in Crystalyx Brigade.[2]

Cow Nutrition Post-Weaning

The time period following weaning is the best time for cows to improve their condition; therefore, satisfying their requirements is vital. Energy and protein requirements increase as a cow progresses from post-weaning to late gestation. For example, a 1400 pound cow requires about 12.2 pounds TDN and 1.68 pounds CP post-weaning, but requires about 14.4 pounds TDN and 2.15 pounds CP during late gestation. Be sure to manipulate your ration accordingly.[1]

Please see the last chapter, "Supplementary Material," for applicable examples concerning the nutrient requirement for cows and calves.

Fall Summary Calendar

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	Dec. 1 Precondition	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	Dec. 19 Wean replacement calves	Dec. 20 Sell non-replacements	21	22	23
24	25	26	27	28	29	30

Note: The fall summary calendar is based off of dates in 2011 and 2012, and is designed to give an estimate of when activities occur at the Grant-Kohrs Ranch. Actual dates from year-to-year vary.

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10. The Merck Veterinary Manual. 2010. Leptospirosis. 10th ed. Merck & Co., Inc., Whitehouse Station, NJ, p. 590-593.

11. The Merck Veterinary Manual. 2010. Respiratory diseases of cattle. 10th ed. Merck & Co., Inc., Whitehouse Station, NJ, p. 1317-1324.

12. VIDO. 2005. Vaccination guidelines. http://www.vido.org/pdfs/vbtg/VaccinationGuidelines.05.pdf. (Accessed Jul. 8, 2014.)

Winter Season

January - March

Please refer to glossary for select definitions.

The winter season, including the months of January through March, at the Grant-Kohrs Ranch is often busy with pregnancy testing, feeding and checking cows, and selling calves. The sections to follow will explain the importance of these events that happen during the winter season.

Pregnancy Testing

Contact your local veterinarian to schedule a pregnancy testing date.

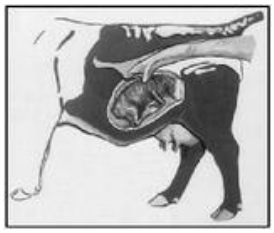
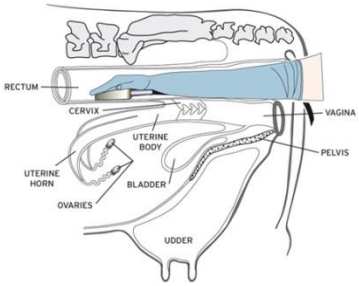
There are many benefits a producer can receive from pregnancy testing cows and heifers. Specific benefits will be listed below; however, pregnancy testing is mainly done to confirm herd health and reproductive status and to determine when cows will calve. The most common methods of pregnancy testing and the methods that will be discussed are rectal palpation and ultrasound. Blood testing has also been developed to confirm pregnancy, but is not as popular as the other methods. At the Grant-Kohrs Ranch, cattle are also given an annual health inspection at the time of pregnancy testing.

Pregnancy via rectal palpation can be detected at as early as 35 days by feeling the uterus, ovaries, and uterine arteries through the rectal wall. Therefore, if a cow is bred around the 23rd of July, an experienced veterinarian should be able to confirm pregnancy at the end of August. Please see the "Cattle Gestation Table" found in the Summer Season document for further information concerning calving date. During pregnancy, the position of the cow's ovaries changes due to the increasing weight of the uterus, pulling the ovaries deeper into the abdominal cavity. It is quite commonly used and is relatively inexpensive.

The use of ultrasound technology has gotten to be very popular over the years. By inserting a probe into the rectum of a cow, one can acquire all of the information received with palpation at as early as 13 days but more commonly at 21 days. Viability of the fetus, incidence of twins, and

sex between 55 and 90 days gestation can also be ascertained by using an ultrasound. Therefore, using the example from above, if a cow at the GRKO Ranch is bred around the 23rd of July, pregnancy can be determined around the 13th of August. To determine the sex of the fetus, more time (55-90 days) would have to be allowed.

The following table compares the pros and cons of the three pregnancy testing methods.

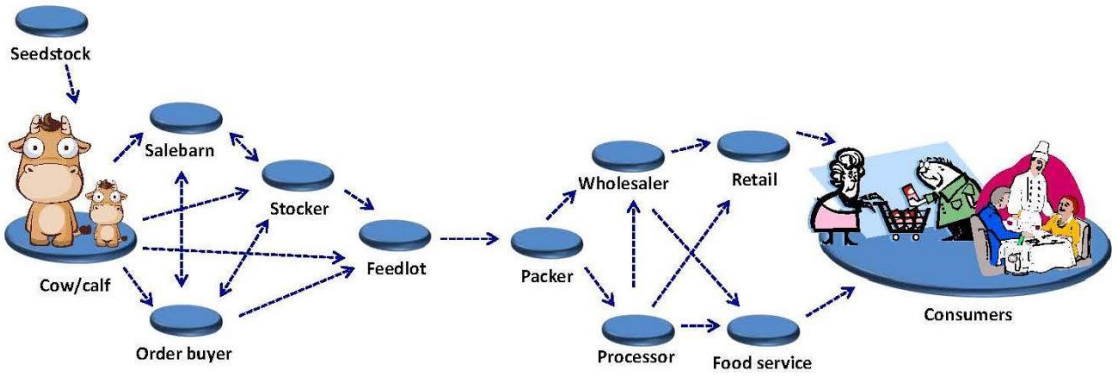
	Pros	Cons
Rectal Palpation 	➢ Detection at 35 days ➢ Low cost ➢ Fairly simple	➢ Potential for rough handling of uterus ➢ Potential for spread of disease ➢ Labor intensive
Ultrasound 	➢ Detection at 21 days ➢ Fast ➢ More information can be determined ➢ Less stress to cow ➢ Less wear & tear to veterinarian	➢ More expensive ➢ Requires equipment & electricity ➢ Potential spread of disease ➢ Fairly labor intensive
Blood Test 	➢ Earliest form of detection ➢ Cheaper than ultrasound ➢ More accurate than palpation ➢ Less invasive	➢ Must wait for results ➢ Inability to accurately determine stage of pregnancy ➢ Sorting may be more labor intensive[1]

As stated earlier, pregnancy testing is associated with many potential benefits to producers. Although producers may pregnancy test for many different reasons, it is always to benefit the operation or the herd in some sort of way. The following list includes some reasons producers may choose to pregnancy test their herd.

- Pregnancy will be detected. Most people do not keep cows that do not get pregnant, so those cows can be separated and sold early etc. This will save the cost of feeding cows and heifers over the winter.
- If there is poor fertility throughout the whole herd, reasons can be identified. It could be due to infectious disease (BVD, IBR, brucellosis, etc.), bull infertility, or inadequate nutrition before breeding etc.
- Pregnancy testing can give the age of the calf and the estimated calving date. This can help producers prepare for calving time.
- Twins can be detected. If twins are detected, it is important to know which cow is expected to have twins, so that one can pay special attention when she calves. Cows and heifers pregnant with twins are more likely to need assistance.
- Various physical abnormalities that may be noticeable on the reproductive tract or other areas can be identified. These abnormalities may have caused infertility or could potentially be a problem when the cow or heifer calves.

Selling Calves

The following chart gives a good representation of the beef supply chain. Producers should always remember why they are raising cattle.



Buyers may especially be looking to buy calves that are:

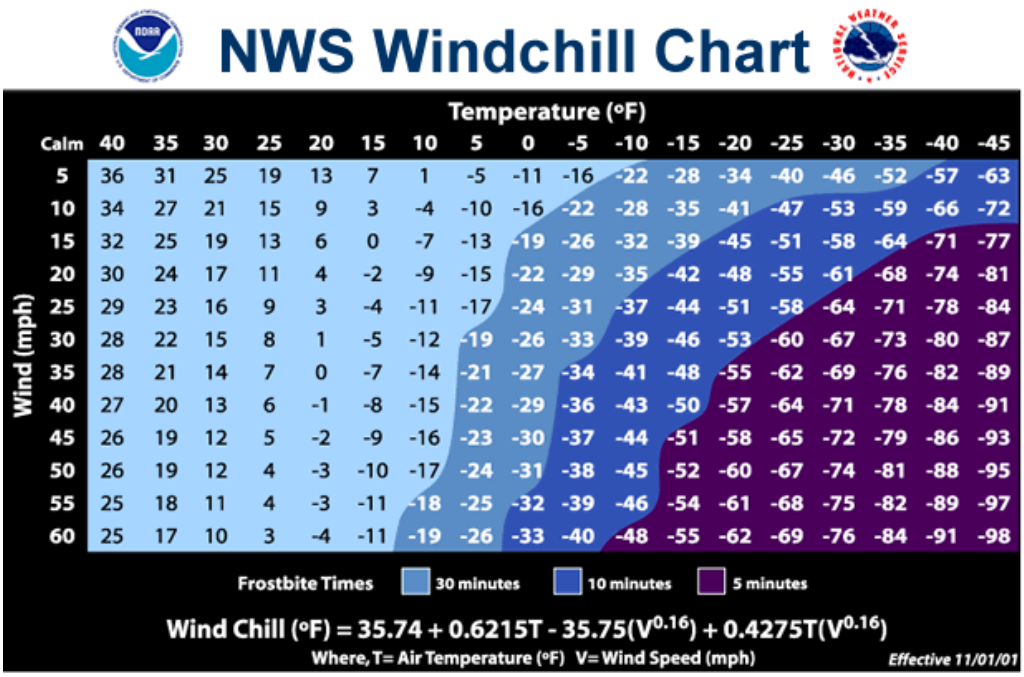
- Weaned
- Spring and fall vaccinations
- Known history
- Not too fleshy
- Fits in a uniform group
- Maybe bunk broke[2]

The Grant-Kohrs Ranch sells most calves through the local auction. They also have an agreement with MT state parks involving grass-fed steers. The purpose of this agreement is to ultimately increase the public's understanding of the open range cattle era by creating interpretive products that are pertinent to national and state park units. While the agreement identifies beef jerky, sausage sticks, hides, and horns, the only interpretive products produced currently is beef jerky and sausage sticks. Through this program, visitors are able to purchase a beef product raised at Grant-Kohrs Ranch National Historic Site as part of their ranching experience.

Winter Nutrition

Depending on the temperature and many other factors, a cow may need additional energy during the winter when it is cooler. Cows maintain their body temperature according to their thermoneutral zone. The thermoneutral zone is the comfort zone where cows do not need to act in a way to gain or expel heat. The zone is encompassed by a lower critical temperature and an upper critical temperature. For example, if the ambient temperature is below a cow's lower critical temperature, the cow could maintain her body temperature by shivering. If the ambient temperature is above a cow's upper critical temperature, she could maintain her body temperature by panting. The lower critical temperature is typically most important to consider during the winter months. Feed should be increased by 1% for each degree below the appropriate critical temperature. Critical temperature is dependent on hair coat (see chart below). Knowing the appropriate critical temperature, temperature, and wind speed can help producers decide if their cows need additional feed during the winter.[3] Remember, energy is the nutrient that is lacking during times when cows need more feed.

Hair Coat	Critical Temperature
Summer coat or wet	59 °F
Fall coat	45° F
Winter coat	32° F
Heavy winter coat	18° F



Question: An 1100 pound cow is exposed to 0°F temperatures and 15 mph winds. It is December (winter coat) and she is eating 20 pounds/day. Does she need to be fed additional feed?

Answer: By looking at both charts, it can be concluded that the cow's lower critical temperature is 32°F, and the effective temperature is -19°F (NWS Windchill Chart). By subtracting the effective temperature from the critical temperature, it is found that feed should be increased by 51% (32-(-19)), as you must increase the amount fed by 1% for each degree below the appropriate critical temperature. The cow should now be receiving 30.2 pounds/day (20*1.51=30.2).

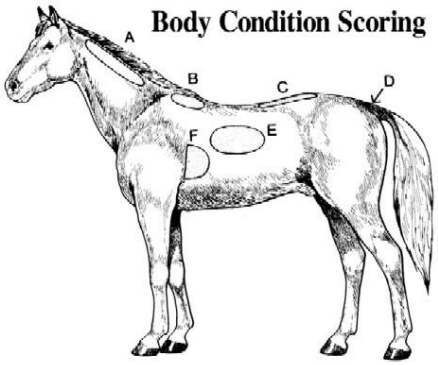
It is necessary for people to feed their cows more during winter for several reasons:

- Nutrient requirements: cows need harvested forages such as: hay, silage, and crop residues to maintain health.
- When the ground is covered in snow, they have nothing to eat.
- For a cow, prepartum nutrition is very important as inadequate energy or protein can negatively affect a cow's colostrum production and quality.

Please see the last chapter, "Supplementary Material," for applicable examples concerning the nutrient requirement for cows and calves.

General Horse Nutrition – BCS

Similar to cattle, a horse's body condition can be evaluated and scored. The body condition score (BCS) system provides an objective method of estimating a horse's fat levels. There are several different scales that can be used; however, for simplicity, the Henneke Scoring System, with a 1-9 scale, will be discussed. Areas on the horse to be evaluated include along the neck, along the withers, tailhead, ribs, behind the shoulders, and the crease down the back. The diagram to the left indicates those evaluation areas.



It has been suggested that the ideal body condition score is between 5 and 6.5. A horse with a 5-6.5 BCS has some fat, but has not yet reached the fleshy point. A horse below a 5 may have fat stores too low to maintain a healthy status if stressed. Horses at a BCS of 3 or lower have virtually no fat reserves and must break down protein from muscle to meet energy requirements if needed. Like with cattle, it is also less likely for a horse to conceive with a BCS below 5. Horses that are too fleshy can also have problems. Fat horses tend to be less agile performers and tire more quickly than trim horses. They are also more prone to laminitis and colic. Furthermore, extremely fat horses (BCS 9) may have endocrine problems and may be hypothyroid.[5]

BCS 1

BCS 2

BCS 5

BCS 6

BCS 9

Body Condition Score	Characteristics
1	Animal extremely emaciated; vertebra, ribs, tailhead, hip joints, and lower pelvic bones projecting prominently; no fatty tissue can be felt
2	Animal emaciated; vertebra, ribs, tailhead, hip joints, lower pelvic bones prominent; some fat covering over base of vertebra; withers, neck, and shoulders faintly visible
3	Slight fat cover over ribs, tailhead prominent but individual vertebra cannot be distinguished; hip joints appear slightly rounded; withers, shoulders, and neck emphasized, lower pelvic bones not noticeable
4	Slight ridge along back; faint outline of ribs noticeable, hip joints not discernable; withers, neck, and shoulders not obviously thin.
5	Back has no crease or ridge; ribs not easily distinguishable but easily felt; shoulders and neck blend smoothly into body
6	May have shallow crease down back; fat around tailhead soft; fat beginning to be deposited along the side of withers, behind shoulders, and along neck
7	May have slight crease down back; individuals ribs can be felt; fat deposited along withers, behind shoulders, and along neck
8	Noticeable crease down back; fat around tailhead very soft; fat area along withers and behind shoulders filled with fat; fat deposited along inner thighs
9	Distinct crease down back; patchy fat appearing over ribs; flank filled with fat; bulging fat around tailhead, along withers and neck, and behind shoulders

Discipline	Appropriate BCS
Endurance	4-5
Polo	4-5
Ranch	4-5
Open Mare	4-6
Stallion (off season)	5-7
Breeding Stallion	4-6
Quarter Horse	5-7
Pony	6-8
Pregnant Mare	6-8

The tables above and to the left can be used at the Grant-Kohrs Ranch to assess the horses at the ranch. By understanding what BCS a specific horse should possess and how to determine the BCS, proper nutrition practices can be implemented. It is important to know an individual horse's BCS before deciding what to feed. Nutrition requirements for horses will be discussed in the subsequent section.[5]

General Horse Nutrition – Requirements

Energy requirements can be divided into maintenance, growth, pregnancy, and work. For each division, equations can be used to determine how many kilocalories a horse requires per kilogram of body weight. On average, a nonworking adult horse requires 33.3 kcal of DE/kg body weight at maintenance. For obese or extremely thin horses, the estimated ideal body weight should be used in the equation, rather than current body weight. Cold weather increases the energy requirement for each degree dropped below the lower critical temperature (LCT). Wind, precipitation, and body condition also affect LCT. The energy requirement for growth also has a specific equation that can be solved to determine minimum dietary energy requirements (DE). The DE provided in the diet should be adjusted to maintain good, lean body condition in growing horses.

During pregnancy and if conditions are ideal, maintenance DE intakes are typically adequate for the first 9 months of gestation. Energy requirements during months 9, 10, and 11 can be estimated by multiplying the maintenance requirements by 1.11, 1.13, and 1.20, respectively. Mares tend to decrease their daily intakes as the fetus grows, so it may be necessary to increase the energy density of the feed by using supplemental concentrates. To support lactation, a horse needs 792 kcal of DE/kg of milk produced per day in addition to the elevated maintenance requirement. This requirement may exceed the need in some breeds.

The energy requirements for work are influenced by factors such as type of work, condition and training of the horse, fatigue, temperature, and skill of the rider or driver. Activities like idling take much less energy than activities like race training. The DE required decreases as the duration of exercise increases and level of activity is maintained. Please see the tables at the end of this section for specific requirements concerning maintenance, growth, pregnancy, and work.

Protein quality in feed for horses is important because the cecum and large intestine cannot synthesize sufficient amino acids needed for growing, working, or lactating horses. Growing horses require 14-16% protein in their ration, while mature horses only require 8-10% protein. Aged horses (>20 years) require approximately the same amount as young, growing horses to maintain body condition. Furthermore, fetal growth during the last third of gestation increases protein requirement to 10-11% of total ration, while lactation increases the requirement to 12-14% of the ration. Work does not significantly increase the protein requirement.

A horse requires several minerals such as calcium, phosphorus, salt, magnesium, potassium, iodine, copper, iron, zinc, and selenium. It is important that a horse does not develop a mineral deficiency or toxicity. Although all minerals play a vital role in the horse's body, calcium and phosphorus deserve special attention because of their involvement with the skeleton. The

skeleton is of fundamental importance to the performance of a horse. The highest calcium and phosphorus requirements are during growth, the last third of gestation, and during lactation. A desirable calcium: phosphorus ratio is approximately 1.5:1.

Vitamins also play a large role in the health and nutrition of horses. Vitamin A, D, E, and K are all needed for certain processes in the body. Ascorbic acid, thiamine, riboflavin, vitamin B_{12}, niacin, and other vitamins are also required. Like with minerals, it is important that horses do not develop a vitamin deficiency or toxicity, as that can have negative outcomes. Please contact your veterinarian, extension agent, or animal nutritionist with any questions concerning horse nutrition and feeding.[4]

Estimated Daily Nutrient Requirements of Growing Horses and Ponies

Daily Nutrients Per Animal[a]

Age (mo)	Body Weight kg	Daily Gain kg	Digestible Energy (Mcal)	Crude Protein (g)	Ca (g)	P (g)	Vitamin A[b] (IU)
Adult weight 200 kg (Ponies)							
4	67	0.34	5.3	268	15.6	8.7	3,000
6	86	0.29	6.2	270	15.5	8.6	3,900
12	128	0.18	7.5	338	15.1	8.4	5,800
18	155	0.11	7.7	320	14.8	8.2	7,000
24	172	0.07	7.5	308	14.7	8.1	7,700
Adult weight 500 kg (average horses)							
4	168	0.84	13.3	669	39.1	21.7	7,600
6	216	0.72	15.5	676	38.6	21.5	9,700
12	321	0.45	18.8	846	37.7	20.9	14,500
18	387	0.29	19.2	799	37.0	20.6	17,400
24	365	0.18	18.7	770	36.7	20.4	19,300
Adult weight 900 kg (draft horses)							
4	303	1.52	23.9	1,204	70.3	39.1	13,600
6	389	1.30	28.0	1,217	69.5	38.7	17,500
12	578	0.82	33.8	1,522	67.8	37.7	26,000
18	697	0.51	34.6	1,438	66.7	37.1	31,400
24	773	0.324	39.2	1,492	66.0	36.7	34,800

[a] Assumes good-quality forage with or without additional concentrates. Maximal daily intake is estimated to be 2.5–3.0% body wt in dry matter.

[b] One mg of β-carotene equals 400 IU of vitamin A for the horse.Adapted from Nutrient Requirements of Horses, 2007, National Academy of Sciences, National Academy Press, Washington, DC.

Estimated Average Daily Nutrient Requirements of Mature Horses and Ponies

Daily Nutrients Per Animal[a]						
Body Weight kg	**Digestible Energy (Mcal)**	**Crude Protein (g)**	**Ca (g)**	**P (g)**	**Vitamin A[b] (IU)**	**Daily Milk Production (kg)**
Maintenance						
200	6.7	252	8	6	6,000	—
500	16.7	630	20	14	15,000	—
900	30.0	1,134	36	25.2	27,000	—
Last 90 Days of Gestation						
214–226	7.7–8.6	319–357	14.4	10.5	12,000	—
500	19.2–21.4	797–893	36	26.3	30,000	—
600	34.6–38.5	1,434–1,607	64.8	47.3	54,000	—
Lactating Mares, First 3 Mo						
200	12.2–12.7	587–614	22.4–23.6	14.4–15.3	12,000	6.0–6.5
500	30.6–31.7	1,468–1,535	55.9–59.0	36.0–38.3	30,000	15.0–16.3
900	52.4–54.4	2,642–2,763	100.6–106.4	64.9–68.9	54,000	26.91–29.3
Lactating Mares, 3 Mo to Weaning						
200	10.9–12.2	506–587	15.0–22.4	9.3–10.5	12,000	4.4–6.0
500	27.2–30.6	1,265–1,468	37.4–55.9	23.2–36.0	30,000	10.9–14.9
900	46.3–52.5	2,277–2,642	67.4–100.6	41.8–64.9	54,000	19.6–26.9

[a] Assumes good-quality forage with or without additional concentrates. Maximal daily intake is estimated to be 2.5–3.0% body wt in dry matter. Ranges are given for requirements that change with time of pregnancy/lactation.

[b] One mg of β-carotene equals 400 IU of vitamin A for the horse.Adapted from Nutrient Requirements of Horses, 2007, National Academy of Sciences, National Academy Press, Washington, DC

Energy Requirements of Work for Light Horses[a] and Desirable Body Condition Scores

Activity	DE (Mcal/day)	Body Condition Score
Idle (maintenance)	0.033 × body wt (kg)	4–6
Halter competition, pleasure trail riding	1.20 × DE for maintenance	5–6
Performance/ show (park, English, and Western pleasure, youth activity), equestrian instruction	1.4 × DE for maintenance	5–6
Ranch work, frequent strenuous show (cutting and roping, barrel racing), endurance trail ride, lower level 3-day event (hunt course, stadium jumping, dressage), polo	1.60 × DE for maintenance	4–5
Race training, and elite 3-day event	1.9 × DE for maintenance	4–5

[a] 200-600 kg body weight

Winter Summary Calendar

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	Jan. 20 Sell calves	21
22	23	24	25	26	27	28
29	30	31	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

Note: The winter summary calendar is based off of dates in 2011 and 2012, and is designed to give an estimate of when activities occur at the Grant-Kohrs Ranch. Actual dates from year-to-year vary.

References

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Supplementary Material

This chapter is designed to serve as a reference for all previous chapters and sections. Information from "Supplementary Material" is included to give specific nutrient balancing examples, as well as to provide additional material that can be used at any time.

Grant-Kohrs Ranch Nutrition Examples

1. Mature cows

Assumptions:
1300-lb cow
Forage analysis used in examples: Big Gulch West Field 2, dated 4/11/14, lab number 12248523
Mineral supplement used in examples: Westfeeds 12:8 Range Mineral with WeatherGuard
Protein supplement used in examples: Crystalyx BreedUp 20

Abbreviations:
DMI = dry matter intake (Note: to convert DMI to as-fed, divide by the DM% of the feedstuff. Example:
26 lb DMI ÷ 0.8869 = 29 lb as fed).
TDN = total digestible nutrients
CP = crude protein
DM = dry matter

Cow Requirements:

Third Trimester

DM basis

DMI	26 lb
TDN	52.75%
CP	7.87%
Calcium	0.26%
Phosphorus	0.16%

Early Lactation

DM basis

DMI	29 lb
TDN	58.35%
CP	10.06%
Calcium	0.29%
Phosphorus	0.20%

Post-Weaning

DM basis

DMI	26 lb
TDN	45.98%
CP	6.23%
Calcium	0.16%
Phosphorus	0.12%

Third Trimester Example:
TDN:
26 lb x 0.5275 = 13.72 lb TDN required
26 lb x 0.614 = 15.96 lb TDN provided by hay
✓ Requirement met by hay alone.

CP:
26 lb x 0.0787 = 2.05 lb CP required
26 lb x 0.0745 = 1.94 lb CP provided by hay
× Requirement not met by hay; still need 0.11 lb CP to meet requirement.
If we feed 0.75 lb per day of BreedUp 20, that will provide 0.15 additional pounds of CP.
✓ Requirement now met by hay plus BreedUp 20.

Calcium:
26 x 0.0026 = 0.0676 lb x 454 g/lb = 31 g Ca required
26 x 0.0056 = 0.1456 lb x 454 g/lb = 66 g Ca provided by hay
✓ Requirement met by hay alone.

Phosphorus:
26 x 0.0016 = 0.0416 lb x 454 g/lb = 19 g P required
26 x 0.0014 = 0.0364 lb x 454 g/lb = 16.5 g P provided by hay
× Requirement not met by hay; still need 2.5 g P to meet requirement.
0.75 lb per day of BreedUp 20 will provide an additional 3.4 g of P.
✓ Requirement now met by hay plus BreedUp 20.

Early Lactation Example:
TDN:
29 lb x 0.5835 = 16.92 lb TDN required
29 lb x 0.614 = 17.81 lb TDN provided by hay
✓ Requirement met by hay alone.

CP:
29 lb x 0.1006 = 2.92 lb CP required
29 lb x 0.0745 = 2.16 lb CP provided by hay
× Requirement not met by hay; still need 0.76 lb CP to meet requirement.
If we feed 0.75 lb per day of BreedUp 20, that will provide 0.15 additional pounds of CP.
× Requirement still not met by hay plus BreedUp 20; still need 0.61 lb CP to meet requirement.

Calcium:
29 x 0.0029 = 0.0841 lb x 454 g/lb = 38 g Ca required
29 x 0.0056 = 0.1624 lb x 454 g/lb = 74 g Ca provided by hay
✓ Requirement met by hay alone.

Phosphorus:
29 x 0.0020 = 0.058 lb x 454 g/lb = 26 g P required
29 x 0.0014 = 0.0406 lb x 454 g/lb = 18 g P provided by hay
× Requirement not met by hay; still need 8 g P to meet requirement.
0.75 lb per day of BreedUp 20 will provide an additional 3.4 g of P.
× Requirement still not met by hay plus BreedUp 20; still need 4.5 g P to meet requirement. See mineral discussion below.

Post-Weaning Example:
TDN:
26 lb x 0.4598 = 11.95 lb TDN required
26 lb x 0.614 = 15.96 lb TDN provided by hay
✓ Requirement met by hay alone.

CP:
26 lb x 0.0623 = 1.62 lb CP required
26 lb x 0.0745 = 1.94 lb CP provided by hay
✓ Requirement met by hay alone.

Calcium:
26 x 0.0016 = 0.0416 lb x 454 g/lb = 19 g Ca required
26 x 0.0056 = 0.1456 lb x 454 g/lb = 66 g Ca provided by hay
✓ Requirement met by hay alone.

Phosphorus:
26 x 0.0012 = 0.0312 lb x 454 g/lb = 14 g P required
26 x 0.0014 = 0.0364 lb x 454 g/lb = 16.5 g P provided by hay
✓ Requirement met by hay alone.

Mineral Requirements, Excluding Ca and P
Note: ppm = mg/kg

	Gestation	Early Lactation
Sulfur (S)	0.15%	0.15%
Potassium (K)	0.60%	0.70%
Magnesium (Mg)	0.12%	0.20%
Sodium (Na)	0.06-0.08%	0.10%
Iron (Fe)	50 ppm	50 ppm
Manganese (Mn)	40 ppm	40 ppm
Copper (Cu)	10 ppm	10 ppm
Zinc (Zn)	30 ppm	30 ppm
Selenium (Se)	0.10 ppm	0.10 ppm

Sulfur, potassium, and zinc are adequate from the hay. Magnesium is adequate for gestation but deficient for early lactation. Iron, manganese, and copper are all deficient. Sodium was not detected in the hay sample, and selenium was not measured.

Conversions for mineral supplement: 2 oz = 56 g = 0.056 kg; 3 oz = 84 g = 0.084 kg

Magnesium:
29 lb x 0.0020 = 0.0580 lb x 454 g/lb = 26 g required during early lactation
29 lb x 0.0013 = 0.0377 lb x 454 g/lb = 17 g provided by the hay
✗ Requirement not met by hay; still need 3 g Mg to meet early lactation requirement.
56 g x 0.025 = 1.4 g Mg provided by 2 oz mineral
84 g x 0.025 = 2.1 g Mg provided by 3 oz mineral

× Requirement not met by hay; still need 1-1.5 g Mg to meet early lactation requirement, depending on mineral intake.

Iron:
26 lb ÷ 2.2 lb/kg = 11.8 kg x 50 mg/kg = 591 mg required during gestation
26 lb ÷ 2.2 lb/kg = 11.8 kg x 39 mg/kg = 460 mg provided by the hay
× Requirement not met by hay; still need 131 mg Fe to meet gestation requirement.
There is no iron in the mineral, although the label reads "iron oxide" – this is commonly known as rust and is in the mineral as a coloring agent. A water sample analysis would be helpful to discover whether or not iron should be added to the mineral or not.

29 lb ÷ 2.2 lb/kg = 13.2 kg x 50 mg/kg = 660 mg required during early lactation
29 lb ÷ 2.2 lb/kg = 13.2 kg x 39 mg/kg = 515 mg provided by the hay
× Requirement not met by hay; still need 145 mg Fe to meet early lactation requirement.
There is no iron in the mineral, although the label reads "iron oxide" – this is commonly known as rust and is in the mineral as a coloring agent. A water sample analysis would be helpful to discover whether or not iron should be added to the mineral or not.

Manganese:
26 lb ÷ 2.2 lb/kg = 11.8 kg x 40 mg/kg = 472 mg required during gestation
26 lb ÷ 2.2 lb/kg = 11.8 kg x 36.8 mg/kg = 434 mg provided by the hay
× Requirement not met by hay; still need 41 mg Mn to meet gestation requirement.
Although not listed on the guaranteed analysis, the mineral does contain 5280 ppm Mn (per Westfeeds).
0.056 kg x 5280 mg/kg = 296 mg provided by 2 oz mineral
0.084 kg x 5280 mg/kg = 444 mg provided by 3 oz mineral
✓ Requirement met by hay plus mineral supplement.

29 lb ÷ 2.2 lb/kg = 13.2 kg x 40 mg/kg = 528 mg required during early lactation
29 lb ÷ 2.2 lb/kg = 13.2 kg x 36.8 mg/kg = 486 mg provided by the hay
× Requirement not met by hay; still need 42 mg Mn to meet early lactation requirement.
Although not listed on the guaranteed analysis, the mineral does contain 5280 ppm Mn (per Westfeeds).
0.056 kg x 5280 mg/kg = 296 mg provided by 2 oz mineral
0.084 kg x 5280 mg/kg = 444 mg provided by 3 oz mineral
✓ Requirement met by hay plus mineral supplement.

Copper:
26 lb ÷ 2.2 lb/kg = 11.8 kg x 10 mg/kg = 118 mg required during gestation
26 lb ÷ 2.2 lb/kg = 11.8 kg x 4.2 mg/kg = 50 mg provided by the hay
× Requirement not met by hay; still need 68 mg Cu to meet gestation requirement.
0.056 kg x 2600 mg/kg = 146 mg provided by 2 oz mineral
0.084 kg x 2600 mg/kg = 218 mg provided by 3 oz mineral
✓ Requirement met by hay plus mineral supplement.

29 lb ÷ 2.2 lb/kg = 13.2 kg x 10 mg/kg = 132 mg required during early lactation

29 lb ÷ 2.2 lb/kg = 13.2 kg x 4.2 mg/kg = 55 mg provided by the hay
✗ Requirement not met by hay; still need 77 mg Cu to meet early lactation requirement.
0.056 kg x 2600 mg/kg = 146 mg provided by 2 oz mineral
0.084 kg x 2600 mg/kg = 218 mg provided by 3 oz mineral
✓ Requirement met by hay plus mineral supplement.

Phosphorus:
✗ Requirement still not met by hay plus BreedUp 20; still need 4.5 g P to meet requirement (see above).
56 g x 0.08 = 4.5 g provided by 2 oz mineral
84 g x 0.08 = 6.7 g provided by 3 oz mineral
✓ Requirement met by hay plus BreedUp 20 plus mineral supplement.

Sodium:
Recall the hay had no detectable sodium. By atomic mass of each element, salt is about 39% sodium and 61% chloride. The mineral contains between 9.25% (min) and 10.75% (max) salt. Depending on salt content and mineral intake, the mineral provides between 2 and 3.5 g of sodium. See work below.

26 lb x 0.0006 = 0.0156 lb x 454 g/lb = 7 g required
26 lb x 0.0008 = 0.0208 lb x 454 g/lb = 9 g required
*During gestation, between 7-9 g Na are required

29 lb x 0.0010 = 0.0290 lb x 454 g/lb = 13 g required during early lactation

At 9.25% salt:
56 g x 0.0925 = 5.18 g salt x 0.39 = 2 g Na provided by 2 oz mineral
84 g x 0.0925 = 7.77 g salt x 0.39 = 3 g Na provided by 3 oz mineral
At 10.75% salt:
56 g x 0.1075 = 6.02 g salt x 0.39 = 2.3 g Na provided by 2 oz mineral
84 g x 0.1075 = 9.03 g salt x 0.39 = 3.5 g Na provided by 3 oz mineral
✗ Requirement not met by mineral supplement.

Selenium:
26 lb ÷ 2.2 lb/kg = 11.8 kg x 0.10 mg/kg = 1.2 mg required during gestation
0.056 kg x 35 mg/kg = 2 mg provided by 2 oz mineral
0.084 kg x 35 mg/kg = 3 mg provided by 3 oz mineral
✓ Requirement met by mineral supplement.

29 lb ÷ 2.2 lb/kg = 13.2 kg x 0.10 mg/kg = 1.3 mg required during early lactation
0.056 kg x 35 mg/kg = 2 mg provided by 2 oz mineral
0.084 kg x 35 mg/kg = 3 mg provided by 3 oz mineral
✓ Requirement met by mineral supplement.

2. Weaned Calves, 500-600 pounds

Assumptions:
550-lb calf gaining 1.5 lb/day
Forage analysis used in examples: Big Gulch West Field 2, dated 4/11/14, lab number 12248523
Mineral supplement used in examples: Westfeeds 12:8 Range Mineral with WeatherGuard

Abbreviations:
DMI = dry matter intake (Note: to convert DMI to as-fed, divide by the DM% of the feedstuff. Example:
26 lb DMI ÷ 0.8869 = 29 lb as fed).
TDN = total digestible nutrients
CP = crude protein
DM = dry matter

Calf Requirements:
DM basis

DMI	13.5 lb
TDN	63%
CP	11%
Calcium	0.41%
Phosphorus	0.21%

Post-Weaning Example:
TDN:
13.5 lb x 0.63 = 8.5 lb TDN required
13.5 lb x 0.614 = 8.3 lb TDN provided by hay
✗ Requirement not met by hay, but if you feed 14 lb on a DM basis, the requirement is met.

CP:
13.5 lb x 0.11 = 1.5 lb CP required
13.5 lb x 0.0745 = 1.00 lb CP provided by hay
✗ Requirement not met by hay

Calcium:
13.5 x 0.0041 = 0.0554 lb x 454 g/lb = 25 g Ca required
13.5 x 0.0056 = 0.0756 lb x 454 g/lb = 34 g Ca provided by hay
✓ Requirement met by hay alone.

Phosphorus:
13.5 x 0.0021 = 0.0284 lb x 454 g/lb = 13 g P required
13.5 x 0.0014 = 0.0789 lb x 454 g/lb = 8.6 g P provided by hay
✗ Requirement not met by hay
✓ Requirement met by hay plus mineral supplement. See mature cow example for amounts of mineral supplied by supplement.

Mineral Requirements, Excluding Ca and P
Note: ppm = mg/kg

	Calf Requirement
Sulfur (S)	0.15%
Potassium (K)	0.60%
Magnesium (Mg)	0.10%
Sodium (Na)	0.06-0.08%
Iron (Fe)	50 ppm
Manganese (Mn)	20 ppm
Copper (Cu)	10 ppm
Zinc (Zn)	30 ppm
Selenium (Se)	0.10 ppm

Sulfur, potassium, magnesium, manganese, and zinc are adequate from the hay. Iron and copper are deficient. Sodium was not detected in the hay sample, and selenium was not measured.

Conversions for mineral supplement: 2 oz = 56 g = 0.056 kg; 3 oz = 84 g = 0.084 kg

Iron:
13.5 lb ÷ 2.2 lb/kg = 6.1 kg x 50 mg/kg = 305 mg required
13.5 lb ÷ 2.2 lb/kg = 6.1 kg x 39 mg/kg = 238 mg provided by the hay
✗ Requirement not met by hay; still need 67 mg Fe to meet requirement.
There is no iron in the mineral, although the label reads "iron oxide" – this is commonly known as rust and is in the mineral as a coloring agent. A water sample analysis would be helpful to discover whether or not iron should be added to the mineral or not.

Copper:
13.5 lb ÷ 2.2 lb/kg = 6.1 kg x 10 mg/kg = 61 mg required
13.5 lb ÷ 2.2 lb/kg = 6.1 kg x 4.2 mg/kg = 26 mg provided by the hay
✗ Requirement not met by hay; still need 35 mg Cu to meet gestation requirement.
✓ Requirement met by hay plus mineral supplement. See mature cow example for amounts of mineral supplied by supplement.

Sodium:
Recall the hay had no detectable sodium. By atomic mass of each element, salt is about 39% sodium and 61% chloride. The mineral contains between 9.25% (min) and 10.75% (max) salt. Depending on salt content and mineral intake, the mineral provides between 2 and 3.5 g of sodium. The amount required by the calves is 3.7-5 g. See work in mature cow example.

Selenium:
13.5 lb ÷ 2.2 lb/kg = 6.1 kg x 0.10 mg/kg = 0.61 mg required
✓ Requirement met by mineral supplement. See mature cow example for amounts of mineral supplied by supplement.

3. Pregnant Replacement Heifers

Assumptions:
1300-lb mature weight

Forage analysis used in examples: Big Gulch West Field 2, dated 4/11/14, lab number 12248523
Mineral supplement used in examples: Westfeeds 12:8 Range Mineral with WeatherGuard

Abbreviations:
DMI = dry matter intake
TDN = total digestible nutrients
CP = crude protein
DM = dry matter

Cow Requirements:

First Trimester
DM basis

DMI	21 lb
TDN	50.7%
CP	7.2%
Calcium	0.23%
Phosphorus	0.18%

Second Trimester
DM basis

DMI	23 lb
TDN	51.6%
CP	7.3%
Calcium	0.22%
Phosphorus	0.18%

Third Trimester
DM basis

DMI	25 lb
TDN	56.4%
CP	8.6%
Calcium	0.30%
Phosphorus	0.22%

First Trimester Example:
TDN:
✓ Requirement met by hay alone. Note the percent TDN in the hay is higher than the percent TDN required. See mature cow example for more detail.

CP:
✓ Requirement met by hay alone.

Calcium:
✓ Requirement met by hay alone.

Phosphorus:
21 x 0.0018 = 0.0378 lb x 454 g/lb = 17 g P required
21 x 0.0014 = 0.0294 lb x 454 g/lb = 13 g P provided by hay
× Requirement not met by hay; still need 4 g P to meet requirement.
✓ Requirement met by hay plus mineral. See mature cow example for amounts of mineral supplied by supplement.

Second Trimester Example:
TDN:
✓ Requirement met by hay alone.

CP:
✓ Requirement met by hay alone.

Calcium:
✓ Requirement met by hay alone.

Phosphorus:
23 x 0.0018 = 0.0414 lb x 454 g/lb = 19 g P required
23 x 0.0014 = 0.0322 lb x 454 g/lb = 14.6 g P provided by hay
✗ Requirement not met by hay; still need 4.4 g P to meet requirement.
✓ Requirement met by hay plus mineral. See mature cow example for amounts of mineral supplied by supplement.

Third Trimester Example:
TDN:
✓ Requirement met by hay alone.

CP:
25 lb x 0.0860 = 2.15 lb CP required
25 lb x 0.0745 = 1.86 lb CP provided by hay
✗ Requirement not met by hay; still need 0.29 lb CP to meet requirement.

Calcium:
✓ Requirement met by hay alone.

Phosphorus:
25 x 0.0022 = 0.055 lb x 454 g/lb = 25 g P required
25 x 0.0014 = 0.035 lb x 454 g/lb = 16 g P provided by hay
✗ Requirement not met by hay; still need 9 g P to meet requirement.
✗ Requirement not met by hay plus mineral. See mature cow example for amounts of mineral supplied by supplement.

Mineral Requirements, Excluding Ca and P
Same as mature cow requirements. See mature cow example for calculations.

4. First-Calf Heifers

Assumptions:
1300-lb mature weight
Forage analysis used in examples: Big Gulch West Field 2, dated 4/11/14, lab number 12248523
Mineral supplement used in examples: Westfeeds 12:8 Range Mineral with WeatherGuard

Abbreviations:
DMI = dry matter intake
TDN = total digestible nutrients
CP = crude protein
DM = dry matter

Cow Requirements:

Early Lactation

DM basis

DMI	25 lb
TDN	60.1%
CP	10.1%
Calcium	0.30%
Phosphorus	0.19%

Late Lactation

DM basis

DMI	25 lb
TDN	56.7%
CP	8.7%
Calcium	0.25%
Phosphorus	0.17%

Post-Weaning

DM basis

DMI	23 lb
TDN	50%
CP	7.1%
Calcium	0.19%
Phosphorus	0.13%

Third Trimester

DM basis

DMI	24 lb
TDN	56.5%
CP	8.6%
Calcium	0.29%
Phosphorus	0.17%

Early Lactation Example:

TDN:

✓ Requirement met by hay alone. Note the percent TDN in the hay is higher than the percent TDN required. See mature cow example for more detail.

CP:

25 lb x 0.1010 = 2.53 lb CP required

25 lb x 0.0745 = 1.86 lb CP provided by hay

× Requirement not met by hay; still need 0.67 lb CP to meet requirement.

Calcium:

✓ Requirement met by hay alone.

Phosphorus:

25 x 0.0019 = 0.0475 lb x 454 g/lb = 22 g P required

25 x 0.0014 = 0.0350 lb x 454 g/lb = 16 g P provided by hay

× Requirement not met by hay; still need 6 g P to meet requirement.

✓ Requirement met by hay plus 3 oz mineral; still deficient at 2 oz mineral. See mature cow example for amounts of mineral supplied by supplement.

Late Lactation Example:

TDN:

✓ Requirement met by hay alone.

CP:

25 lb x 0.0870 = 2.18 lb CP required

25 lb x 0.0745 = 1.86 lb CP provided by hay

× Requirement not met by hay; still need 0.32 lb CP to meet requirement.

Calcium:

✓ Requirement met by hay alone.

Phosphorus:

25 x 0.0017 = 0.0425 lb x 454 g/lb = 19 g P required

25 x 0.0014 = 0.0350 lb x 454 g/lb = 16 g P provided by hay

× Requirement not met by hay; still need 3 g P to meet requirement.

✓ Requirement met by hay plus mineral. See mature cow example for amounts of mineral supplied by supplement.

Post-Weaning Example:
TDN:
✓ Requirement met by hay alone.

CP:
✓ Requirement met by hay alone.

Calcium:
✓ Requirement met by hay alone.

Phosphorus:
✓ Requirement met by hay alone.

Third Trimester Example:
TDN:
✓ Requirement met by hay alone.

CP:
24 lb x 0.0860 = 2.06 lb CP required
24 lb x 0.0745 = 1.79 lb CP provided by hay
× Requirement not met by hay; still need 0.27 lb CP to meet requirement.

Calcium:
✓ Requirement met by hay alone.

Phosphorus:
24 x 0.0017 = 0.0408 lb x 454 g/lb = 19 g P required
24 x 0.0014 = 0.0336 lb x 454 g/lb = 15 g P provided by hay
× Requirement not met by hay; still need 4 g P to meet requirement.
✓ Requirement met by hay plus mineral. See mature cow example for amounts of mineral supplied by supplement.

Mineral Requirements, Excluding Ca and P
Same as mature cow requirements. See mature cow example for calculations.

Table 2. Nutrient requirements of beef cows.

Gestating cow, middle 1/3 of pregnancy

				Diet Nutrient Density					Daily Nutrients per Animal				
Weight	Expected Calf	DM Intake		TDN	NEm	CP	Ca	P	TDN	NEm	CP	Ca	P
(lb)	Birthweight (lb)	(lb/day)	% of BW	(%DM)	(Mcal/lb)	(%DM)	(%DM)	(%DM)	(lb)	(Mcal)	(lb)	(lb)	(lb)
900	63	17	1.9	50	0.44	7.1	0.17	0.14	8.3	7.3	1.2	0.028	0.023
1000	69	18	1.8	50	0.44	7.1	0.17	0.14	9.0	7.9	1.3	0.031	0.025
1100	75	19	1.8	50	0.44	7.1	0.17	0.14	9.7	8.5	1.4	0.034	0.028
1200	80	21	1.7	50	0.44	7.1	0.18	0.15	10.3	9.1	1.5	0.037	0.030
1300	86	22	1.7	50	0.44	7.1	0.18	0.15	11.0	9.7	1.6	0.040	0.033
1400	91	23	1.7	50	0.44	7.1	0.19	0.15	11.6	10.2	1.6	0.043	0.035
1500	96	25	1.6	50	0.44	7.1	0.19	0.15	12.2	10.8	1.7	0.046	0.038
Gestating cow, last 1/3 of pregnancy													
900	63	19	2.1	54	0.50	7.9	0.25	0.16	10.3	9.6	1.5	0.047	0.030
1000	69	21	2.1	54	0.50	7.9	0.25	0.16	11.2	10.4	1.6	0.052	0.034
1100	75	22	2.0	54	0.50	7.9	0.25	0.16	12.1	11.2	1.8	0.057	0.037
1200	80	24	2.0	54	0.50	7.9	0.26	0.17	12.9	12.0	1.9	0.061	0.040
1300	86	25	2.0	54	0.50	7.9	0.26	0.17	13.7	12.8	2.0	0.066	0.043
1400	91	27	1.9	54	0.50	7.9	0.26	0.17	14.5	13.5	2.1	0.071	0.046
1500	96	28	1.9	54	0.50	7.9	0.27	0.17	15.3	14.2	2.2	0.075	0.049

Lactating cow, first 90 days after calving

				Diet Nutrient Density					Daily Nutrients per Animal				
Weight	Peak Milk	DM Intake		TDN	NEm	CP	Ca	P	TDN	NEm	CP	Ca	P
(lb)	lb/day	(lb/day)	% of BW	(%DM)	(Mcal/lb)	(%DM)	(%DM)	(%DM)	(lb)	(Mcal)	(lb)	(lb)	(lb)
	10	22	2.5	56	0.53	8.7	0.24	0.17	12.4	11.7	1.9	0.052	0.037
900	15	24	2.7	57	0.55	9.6	0.27	0.18	13.7	13.3	2.3	0.065	0.044
	20	26	2.9	59	0.58	10.4	0.30	0.20	15.3	14.9	2.7	0.077	0.051
	10	24	2.4	55	0.52	8.5	0.23	0.17	13.0	12.3	2.0	0.055	0.039
1000	15	26	2.6	57	0.55	9.4	0.27	0.18	14.5	14.0	2.4	0.068	0.047
	20	27	2.7	59	0.57	10.2	0.29	0.20	16.0	15.6	2.8	0.080	0.054
	15	27	2.5	57	0.54	9.2	0.26	0.18	15.3	14.6	2.5	0.071	0.049
1100	20	29	2.6	58	0.56	10.0	0.29	0.19	16.8	16.3	2.9	0.083	0.056
	25	31	2.8	59	0.58	10.6	0.31	0.21	18.2	17.9	3.3	0.095	0.064
	15	29	2.4	57	0.54	9.0	0.26	0.18	16.1	15.3	2.6	0.074	0.051
1200	20	30	2.5	58	0.56	9.8	0.28	0.19	17.6	16.9	3.0	0.086	0.059
	25	32	2.7	59	0.58	10.5	0.31	0.21	19.0	18.6	3.4	0.098	0.066
	15	30	2.3	56	0.53	8.9	0.26	0.18	16.8	16.0	2.7	0.077	0.054
1300	20	32	2.4	57	0.55	9.6	0.28	0.19	18.1	17.6	3.1	0.089	0.061
	25	34	2.6	59	0.57	10.3	0.30	0.20	19.7	19.2	3.4	0.102	0.069
	20	33	2.4	57	0.55	9.5	0.28	0.19	18.9	18.2	3.1	0.092	0.064
1400	25	35	2.5	59	0.57	10.1	0.30	0.20	20.5	19.8	3.5	0.105	0.071
	30	37	2.6	59	0.58	10.6	0.32	0.21	21.8	21.5	3.9	0.117	0.078
	20	35	2.3	57	0.55	9.3	0.28	0.19	19.7	18.8	3.2	0.095	0.066
1500	25	37	2.4	58	0.56	9.9	0.30	0.20	21.2	20.5	3.6	0.108	0.073
	30	38	2.6	59	0.58	10.5	0.31	0.21	22.6	22.1	4.0	0.120	0.081

Table 3. Nutrient requirements of pregnant replacement heifers.

Pregnant yearling replacement heifer, middle 1/3 of pregnancy

Current Weight (lb)	Current BCS[a] (1-9)	ADG[b] (lb)	DM Intake (lb/day)	DM Intake % of BW	Diet Nutrient Density TDN (%DM)	NEm (Mcal/lb)	CP (%DM)	Ca (%DM)	P (%DM)	Daily Nutrients per Animal TDN (lb)	NEm (Mcal)	CP (lb)	Ca (lb)	P (lb)
1000 lb Mature Weight @ BCS=5														
		1.0	13	2.2	54	0.49	9.1	0.42	0.17	7.2	6.6	1.2	0.057	0.023
600	5	1.5	14	2.3	56	0.53	10.2	0.48	0.20	7.8	7.4	1.4	0.066	0.028
		2.0	15	2.4	59	0.58	11.4	0.53	0.23	8.5	8.4	1.6	0.077	0.033
		1.0	15	2.2	54	0.50	8.5	0.38	0.16	8.2	7.6	1.3	0.058	0.025
700	6	1.5	16	2.3	57	0.55	9.5	0.43	0.19	9.0	8.7	1.5	0.068	0.030
		2.0	17	2.4	60	0.59	10.4	0.47	0.21	9.9	9.8	1.7	0.078	0.034
		1.0	16	2.0	56	0.53	8.4	0.37	0.16	9.2	8.7	1.4	0.060	0.027
800	7	1.5	17	2.1	59	0.58	9.1	0.41	0.18	10.1	9.9	1.6	0.069	0.031
		2.0	18	2.2	62	0.62	9.8	0.44	0.20	11.0	11.0	1.7	0.077	0.035
1200 lb Mature Weight @ BCS=5														
		1.0	16	2.1	53	0.48	8.7	0.40	0.17	8.3	7.6	1.4	0.062	0.026
750	5	1.5	16	2.2	55	0.52	9.8	0.45	0.19	9.0	8.5	1.6	0.073	0.032
		2.0	17	2.3	58	0.56	10.7	0.49	0.22	9.8	9.5	1.8	0.083	0.037
		1.0	17	2.0	54	0.49	8.2	0.37	0.16	9.3	8.6	1.4	0.064	0.028
850	6	1.5	18	2.1	56	0.53	9.1	0.41	0.18	10.2	9.6	1.6	0.074	0.033
		2.0	19	2.2	59	0.57	9.9	0.45	0.20	11.0	10.8	1.9	0.084	0.038
		1.0	19	1.9	56	0.52	8.2	0.36	0.16	10.3	9.7	1.5	0.067	0.030
950	7	1.5	19	2.0	58	0.56	8.9	0.39	0.18	11.1	10.8	1.7	0.075	0.035
		2.0	20	2.1	61	0.60	9.4	0.42	0.19	12.0	11.9	1.9	0.083	0.038
1400 lb Mature Weight @ BCS=5														
		1.0	18	2.0	53	0.48	8.5	0.38	0.17	9.4	8.5	1.5	0.068	0.030
900	5	1.5	18	2.0	55	0.51	9.3	0.42	0.19	10.0	9.4	1.7	0.078	0.035
		2.0	19	2.1	57	0.55	10.1	0.46	0.21	10.9	10.5	1.9	0.088	0.040
		1.0	20	1.9	53	0.49	8.0	0.36	0.16	10.3	9.4	1.6	0.069	0.032
1000	6	1.5	20	2.0	56	0.52	8.9	0.40	0.18	11.2	10.6	1.8	0.080	0.037
		2.0	21	2.1	58	0.56	9.5	0.43	0.20	12.1	11.7	2.0	0.089	0.041
		1.0	21	1.9	55	0.52	8.0	0.35	0.17	11.3	10.6	1.6	0.072	0.034
1100	7	1.5	21	1.9	58	0.55	8.7	0.39	0.18	12.2	11.8	1.9	0.082	0.039
		2.0	22	2.0	60	0.59	9.3	0.41	0.20	13.2	13.0	2.0	0.091	0.043

[a] Body Condition Score

[b] Average Daily Gain

Table 3. Nutrient requirements of pregnant replacement heifers (continued).

Pregnant yearling replacement heifer, last 1/3 of pregnancy

Current Weight (lb)	Current BCS (1-9)	ADG (lb)	DM Intake (lb/day)	DM Intake % of BW	Diet Nutrient Density TDN (%DM)	NEm (Mcal/lb)	CP (%DM)	Ca (%DM)	P (%DM)	Daily Nutrients per Animal TDN (lb)	NEm (Mcal)	CP (lb)	Ca (lb)	P (lb)
1000 lb Mature Weight @ BCS=5														
		1.0	16	2.2	57	0.54	8.8	0.28	0.17	8.9	8.5	1.4	0.044	0.027
700	5	1.5	17	2.4	60	0.59	9.9	0.34	0.20	9.9	9.8	1.6	0.055	0.032
		2.0	17	2.4	63	0.64	10.9	0.39	0.22	10.7	10.9	1.9	0.066	0.038
		1.0	17	2.1	55	0.52	8.8	0.28	0.17	9.4	8.8	1.5	0.047	0.029
800	6	1.5	18	2.3	60	0.59	9.4	0.32	0.19	10.9	10.8	1.7	0.058	0.034
		2.0	19	2.4	63	0.64	10.2	0.36	0.21	11.9	12.0	1.9	0.067	0.039
		1.0	18	2.0	57	0.54	8.8	0.28	0.18	10.2	9.7	1.6	0.051	0.032
900	7	1.5	19	2.1	62	0.62	9.3	0.31	0.19	11.8	11.8	1.8	0.060	0.036
		2.0	20	2.2	65	0.66	9.9	0.34	0.20	12.8	13.1	2.0	0.068	0.040
1200 lb Mature Weight @ BCS=5														
		1.0	18	2.1	57	0.54	8.5	0.27	0.17	10.3	9.8	1.5	0.049	0.031
850	5	1.5	19	2.2	59	0.57	9.4	0.32	0.19	10.9	10.7	1.8	0.060	0.036
		2.0	19	2.3	61	0.61	10.3	0.36	0.21	11.8	11.7	2.0	0.070	0.041
		1.0	19	2.0	55	0.52	8.4	0.27	0.17	10.6	10.0	1.6	0.052	0.033
950	6	1.5	20	2.2	59	0.58	9.1	0.31	0.19	12.1	11.8	1.9	0.063	0.039
		2.0	21	2.2	62	0.62	9.8	0.34	0.20	13.0	13.0	2.1	0.072	0.043
		1.0	20	1.9	57	0.54	8.5	0.27	0.18	11.4	10.9	1.7	0.055	0.036
1050	7	1.5	21	2.0	61	0.60	9.1	0.30	0.19	12.9	12.8	1.9	0.065	0.040
		2.0	22	2.1	63	0.64	9.6	0.33	0.20	13.8	14.0	2.1	0.073	0.044
1400 lb Mature Weight @ BCS=5														
		1.0	21	2.0	56	0.52	8.3	0.26	0.17	11.4	10.8	1.7	0.054	0.035
1020	5	1.5	21	2.1	58	0.55	9.2	0.31	0.19	12.2	11.7	1.9	0.066	0.040
		2.0	22	2.1	60	0.59	9.8	0.34	0.21	12.9	12.7	2.1	0.074	0.045
		1.0	22	2.0	55	0.52	8.2	0.26	0.17	12.0	11.3	1.8	0.057	0.037
1120	6	1.5	23	2.0	58	0.56	8.9	0.30	0.19	13.2	12.8	2.0	0.069	0.043
		2.0	23	2.1	60	0.59	9.4	0.33	0.20	14.1	13.9	2.2	0.077	0.047
		1.0	23	1.9	57	0.54	8.3	0.27	0.18	12.8	12.2	1.9	0.060	0.040
1220	7	1.5	24	1.9	60	0.59	8.8	0.30	0.19	14.0	13.8	2.1	0.070	0.044
		2.0	24	2.0	62	0.62	9.4	0.33	0.20	15.1	15.1	2.3	0.079	0.049

Table 3. Nutrient requirements of pregnant replacement heifers (continued).

Lactating first-calf heifer, first 90 days after calving

Current Weight (lb)	Current BCS (1-9)	ADG (lb)	DM Intake (lb/day)	DM Intake % of BW	Diet Nutrient Density TDN (%DM)	NEm (Mcal/lb)	CP (%DM)	Ca (%DM)	P (%DM)	Daily Nutrients per Animal TDN (lb)	NEm (Mcal)	CP (lb)	Ca (lb)	P (lb)
1000 lb Mature Weight @ BCS=5														
		0.0	19	2.7	59	0.58	10.1	0.27	0.19	11.0	10.8	1.9	0.051	0.035
700	5	0.5	20	2.9	64	0.65	12.0	0.36	0.23	12.9	13.1	2.4	0.072	0.046
		1.0	22	3.1	68	0.70	13.5	0.42	0.26	14.7	15.4	2.9	0.091	0.057
		0.0	20	2.6	60	0.59	9.7	0.26	0.18	12.2	12.0	2.0	0.054	0.037
800	6	0.5	22	2.8	64	0.65	11.3	0.34	0.22	14.1	14.3	2.5	0.074	0.048
		1.0	24	3.0	68	0.70	12.7	0.39	0.25	16.0	16.7	3.0	0.093	0.058
		0.0	21	2.4	60	0.59	9.8	0.27	0.19	12.7	12.5	2.1	0.057	0.040
900	7	0.5	23	2.6	66	0.67	11.2	0.33	0.22	15.1	15.6	2.6	0.077	0.050
		1.0	25	2.7	70	0.73	12.4	0.38	0.24	17.1	18.0	3.1	0.094	0.060
1200 lb Mature Weight @ BCS=5														
		0.0	21	2.5	59	0.57	9.7	0.27	0.19	12.3	12.0	2.0	0.057	0.039
850	5	0.5	23	2.7	62	0.62	11.3	0.34	0.22	14.1	14.1	2.6	0.076	0.049
		1.0	24	2.9	66	0.68	12.8	0.40	0.25	16.1	16.6	3.1	0.097	0.061
		0.0	23	2.4	59	0.57	9.3	0.26	0.18	13.3	12.9	2.1	0.059	0.041
950	6	0.5	25	2.6	63	0.63	10.9	0.32	0.21	15.3	15.4	2.7	0.079	0.052
		1.0	26	2.7	66	0.68	12.1	0.37	0.24	17.2	17.8	3.2	0.098	0.062
		0.0	24	2.2	61	0.60	9.4	0.26	0.18	14.3	14.2	2.2	0.062	0.043
1050	7	0.5	25	2.4	65	0.66	10.8	0.32	0.21	16.3	16.7	2.7	0.082	0.054
		1.0	27	2.6	68	0.71	11.9	0.37	0.24	18.3	19.1	3.2	0.099	0.064
1400 lb Mature Weight @ BCS=5														
		0.0	24	2.3	58	0.55	9.3	0.26	0.18	13.5	13.1	2.2	0.061	0.043
1020	5	0.5	25	2.5	61	0.61	10.8	0.32	0.21	15.4	15.4	2.7	0.082	0.054
		1.0	27	2.6	65	0.66	12.1	0.38	0.24	17.4	17.8	3.3	0.102	0.065
		0.0	25	2.3	58	0.56	9.0	0.25	0.18	14.6	14.2	2.3	0.064	0.045
1120	6	0.5	27	2.4	62	0.62	10.4	0.31	0.21	16.6	16.6	2.8	0.084	0.056
		1.0	29	2.6	65	0.66	11.6	0.36	0.23	18.6	19.1	3.3	0.103	0.066
		0.0	27	2.2	62	0.62	9.8	0.28	0.20	16.7	16.7	2.7	0.077	0.053
1220	7	0.5	29	2.4	65	0.67	11.1	0.34	0.22	18.8	19.3	3.2	0.097	0.064
		1.0	30	2.5	68	0.72	12.1	0.38	0.24	20.8	21.8	3.7	0.115	0.074

Water Requirements

Water is the most important nutrient to an animal. It is the largest constituent of the body, and is required in the greatest amount. Water quantity and quality must be considered when analyzing water requirements. Because city and live water, and some groundwater are the main sources of water at the Grant-Kohrs Ranch, quality issues should not be as prevalent; however, it is still a possibility that those sources may need to be tested yearly.

As a general rule, a cow should drink three times as much water as she consumes in dry matter, and four times as much water when she is lactating. For example, if a non-lactating cow is consuming 25 pounds of dry matter, she would need to drink approximately 75 pounds of water (25 lbs * 3). By converting pounds to gallons, you would find that the cow would need to drink about 9.38 gallons of water per day. If she were lactating and consuming 25 pounds of dry matter, 12.5 gallons would be needed. Water requirements are not only dependent on dry matter consumption, but also on temperature. Water requirements stay fairly constant until 40 degrees Fahrenheit, but increase with temperature from there.

Quantity of water consumed is extremely important; however, the quality of water is just as important. Poor water quality can and will have an array of adverse effects on cattle. The following table shows values that can be used as a guide in determining water quality. Water samples can be taken to your local Extension office for further examination. Samples should be in a clean polyethylene or glass bottle that is filled to the brim and sealed tightly. All samples should be properly labeled with source, date of sampling, contact information, and intended use of water.

Total Dissolved Solids (TDS)	< 1000 ppm is desirable
Sulfates	< 500 ppm is desirable
Alkalinity – Bicarbonates, carbonates	< 1000 ppm is desirable
Nitrates	< 100-300 ppm is desirable

Some effects that can occur due to poor water quality include:

- Reduced water and feed consumption
- Poor feed efficiency
- Compromised health
- Disease
- Diarrhea
- Possible death

Glossary

A

Abattoir – a slaughterhouse.

Abortion – the expulsion of a fetus from the uterus before it is able to survive independently.

Acute – present or experienced to a severe or intense degree.

Anaerobic – relating to, involving, or requiring an absence of free oxygen.

Apoptosis – the death of cells that occurs as a normal and controlled part of an organism's growth or development.

Ataxia – the loss of full control of bodily movements.

Atophy – waste away, typically due to the degeneration of cells, or become vestigial during evolution.

B

Biosecurity – procedures intended to protect humans or animals against harmful biological agents.

C

Calving interval – interval between successive calvings of a cow.

Colostrum – the first secretion from the mammary glands after giving birth, rich in antibodies.

Conjunctivitis – inflammation of the conjunctiva of the eye.

D

Dermatits – a condition of the skin in which it becomes irritated, resulting from direct irritation of the skin by an external agent or an allergic reaction to it.

Dysentery – infection of the intestines resulting in severe diarrhea with the presence of blood and mucus in the feces.

Dyspnea – difficult or labored breathing.

Dystocia – difficult birth, typically caused by a large or awkwardly positioned fetus, small opening of the maternal pelvis, or failure of the uterus and cervix to contract and expand normally.

E

Edema – a condition characterized by an excess of watery fluid collecting in the cavities or tissues of the body.

Emaciated – abnormally thin or weak, especially because of illness or a lack of food.

Enterotoxigenic – producing an enterotoxin.

Envenomation – the process by which venom is injected into some animal by the bite (or sting) of a venomous animal.

Enzootic – of, relating to, or denoting a disease that regularly affects animals in a particular district or at a particular season.

F

Fetid – smelling extremely unpleasant.

Fomite – an object or substance that is capable of transmitting infectious organisms.

G

Gadding – going around from one place to another.

Gait – the paces of an animal.

Gangrene – localized death and decomposition of body tissue, resulting from either obstructed circulation or bacterial infection.

H

Hematophagous – feeding on blood.

Hemolysis – the rupture of destruction of red blood cells.

Heterosis – the tendency of a crossbred individual to show qualities superior to those of both parents.

I

Immunosuppression – the partial or complete suppression of the immune response of an individual.

J

Jaundice – a medical condition with yellowing of skin or whites of the eyes.

L

Lethargy – a lack of energy and enthusiasm.

Leukosis – a leukemic disease of animals, especially one of a group of malignant viral diseases of poultry or cattle.

Lymphadenopathy – a disease affecting the lymph nodes.

M

Mastitis – inflammation of the mammary gland in the udder.

Mummification – intrauterine death of the fetus, and failure to abort resulting in resorption of fetal fluids, dehydration of fetal tissue and associated membranes.

Myiasis – the parasitic infestation of the body of a live mammal by fly larvae that grow inside the host while feeding on its tissue.

Myocarditis – inflammation of the heart muscle.

N

Necropsy – another term for autopsy.

Necrosis – the death of most or all the cells in an organ or tissue due to disease, injury, or failure of the blood supply.

O

Opacity – the condition of lacking transparency or translucence.

Opithotonos – spasm of the muscles causing backward arching of the head, neck, and speine, as in severe tetanus, some kinds of meningitis, and strychnine poisoning.

P

Palpation – process of using one's hands to examine the body, especially while perceiving/ diagnosing a disease or illness.

Paresis – a condition of muscular weakness caused by nerve damage or disease; partial paralysis.

Parturition – the action of giving birth.

Pathogen – a bacterium, virus, or other microorganism that can cause disease.

Photophobia – extreme sensitivity to light.

Placentitis – inflammation of the placenta.

Prolapse – a slipping forward or down of one of the parts or organs of the body.

Proteolysis – the breakdown of proteins or peptides into amino acids by the action of enzymes.

S

Septicemia – invasion of the bloodstream by virulent microorganisms, especially bacteria or their toxins.

Sternal recumbency – lying down, unable to get up.

Striations – series of ridges, furrows, or linear marks.

Subclinical – relating to or denoting a disease that is not severe enough to present definite or readily observable symptoms.

Systemic – of or relating to a system, especially as opposed to a particular part.

R

Resorption – the process or action by which something is reabsorbed.

T

Thrombosis – local coagulation or clotting of the blood in a part of the circulatory system.

V

Vasculitis – inflammation of a blood vessel or blood vessels.