Planning for Bison Grazing on Native Rangeland

Kristin L. Miller
Rangeland Management Specialist

Bison have been an important part of Native American and early settler culture for centuries. Uses included food and clothing, among others. Once vast-spreading herds became nearly extinct due to great slaughter. By 1894 there was only approximately 500 – 1500 bison remaining in North America. But, some of the early settlers in the Western United States saw the advantages of raising bison. These early private and public herds were valuable in the recovery of the species. Now, estimates by the National Bison Association that there are between 250,000 and 300,000 in the United States.

Bison production has become increasingly more popular through the United States and Canada. Even though the bison industry is quickly becoming a major livestock industry, it is still considered to be a novelty or alternative livestock. However, there continues to be debate amongst bison producers about whether or not bison should be designated as livestock or as wildlife. With the increasing number of producers, there has been increasing demand and need for technical assistance on rangeland and pasture management.

General Bison Information

Bison are herd animals and form family or social groups based on age, season, sex, forage conditions and availability, and habitat. Bison are an extremely mobile and a highly social animal. Bison also have strong herding instincts and the structure of the herd is very important to the group. Activities of the herd such as establishing a "pecking order," protection of the herd, challenges, and other non-grazing activities can be observed regularly.

Social groups of the bison may change during different periods of the life cycle of the bison. During the rut, the groups are usually larger, and during the winter groups usually tend to be fairly small. The lead animal, usually an older cow, in these social groups is very important. The herd will follow the lead animal, which will lead them to different grazing areas and away from danger. Within the group of bulls, there is usually one dominant bull.

Bison Breeding and Calving

Bison production is similar to cattle in many ways, but also very different in others. This makes understanding bison very important when planning a grazing system which utilizes bison as the primary grazing animal.

The life span of an individual bison is over 20 years and the cows may calve well into her 20s. Breeding occurs during the rut period. This phenomenon generally

occurs between late July and August, however it will vary geographically and may be later in the north and sooner in the south. During this time, the cows come into estrus and the bulls join the cow groups.

The female's estrus cycle will usually last from 3 - 4 weeks. Females will usually not breed until they are two years of age, and fertility will tend to decline once she reaches 14 to 15 years of age. Few males under the age of four reproduce in a natural setting, however, they can breed at age two with a lower cow ratio (1:5 vs. 1:10). The ratio is decisively lower than that used for cattle. This is mainly due to the short breeding season of bison.

The gestation of a bison cow is between 270 and 293 days, but usually lasts approximately 275-280 days. The gestation period of cattle is 285 days. The length of gestation in bison is dependent on the nutrition availability, cow body condition, and the geographic location. Typically, bison are very fertile with 85-95% of the cows weaning a calf annually.

Bison have a low rate of dystocia (difficult birth). Bison calves are much smaller than cattle when they are born. The average weight for a bison calf is between 40 and 50 pounds. Bull calves weigh far more tan heifer calves and are much harder on the cow to raise. The mother of a bull calf will be less likely to reproduce the following year if she has been nutritionally stressed.

Foraging Ecology of Bison

Rangeland across the Great Plains developed under grazing pressure, primarily by bison. Grasses and sedges were the dominant species, accounting for about 90 to 98 percent of the forage available. Bison were migratory and would search out areas of desirable grazing forage.

Bison and cattle consume similar forages, but bison will travel greater distances while grazing. Proportions of forages consumed differ; therefore the quality of the diet differs. Forbs were never less than 5% of cattle diets and were never of any importance to bison diets (VanVuren, 1981, and Plumb and Dodd, 1994). Although the use of forbs and browse is limited, bison will consume certain forbs during certain times and bulls tend to utilize browse more than cows. Bison tend to balance nutrient demands by consuming a diet dominant of grasses (Plumb and Dodd, 1994). Bison tend to use higher elevations and steeper slopes than cattle.

Bison are more efficient forage users than cattle. This accounts, in part for the less time they spend grazing than cattle. By being able to consume and digest forages more efficiently than cattle, they can consume a less amount of feed (of the same quality) and be able to meet their nutritional needs.

Bison spend less time grazing, per day grazing than cattle. During the non-rut period, bison graze an average of 4% less time than cattle. This reduction increased to 12% less time grazing during the rut. During the rut, bison spend a large amount of time in social activities. Bison require less water than do cattle or horses and tend to spend a very short time at the watering locations.

Factors Affecting Nutrient Requirements of Bison

Many in the bison industry have theorized that three bison can be grazed for every two cattle on the same acreage as before, or an increase in stocking rates of 150% the cattle stocking rates (Peden, et.al. 1973). There are no studies on intake that show a significant reduction in intake rates of bison compared to similar sized cattle (Norland, 2000). See Table 1 for intake rates of bison compared to cattle. Feedlot studies have shown little to no intake difference between cattle and bison either.

Table 1. Intake rates (as a percent of body weight) of bison vs. cattle during the different seasons.

Animal	Summer	Winter
Bison	2.1 to 2.8%	1.4 to 1.8%
Cattle	2.3 to 2.5%	1.9 to 2.1%

Because there are no significant differences in intake rates between cattle and bison, the standard for a grazing animal unit (AU) should be used to determine stocking rates of bison. An AU is defined as a 1,000-pound mature cow, with a calf less than three months old, or its equivalent. Therefore, one tenth of an animal unit is equal to 100 pounds live weight.

Most mature bison cows weigh about 900 pounds, so a bison is equivalent to 0.9 AU. A bull will vary widely in weight, ranging from 900 to 2000+ pounds. Being able to accurately estimate the weight of the bison is important when determining the amount of forage the animal will consume. Through correct stocking rates and forage use levels, both bison and forage production can be optimized.

Both bison cows and bulls will start a cycle of winter weight loss followed by spring and summer weigh gain at about 18 months old. It is not uncommon for bison to lose 10 to 15% of their pre-winter body weight (Sask. Ag and Food). A loss much higher than 15% of body weight may put the bison at risk. This winter weight loss is a result of reduced metabolic rate and is difficult to change. This makes planning for fall weight gains very important. See Table 2 (from Sask. Ag and Food).

Table 2. Winter vs. summer with respect to day length, metabolism, dry matter intake, and body weight.

	Short Daylight Hours	Long Daylight Hours
Metabolism	Slow	Fast
Dry Matter Intake	Low (1.4-1.8% body wt.)	High (2.2-3.0% body wt.)
Body Weight Status	Maintain or Lose Weight	Maintain or Gain Weight

Planning a Grazing System with Bison

Many people who raise bison or work within the industry question how well a rotational grazing system with bison works. It has been said that bison will naturally rotate and will do a better job of distribution than what man can force them to do. It is true that bison are very good at moving and distributing use in very large areas. They will also use rough terrain and travel greater distances to water than will cattle. However, this is usually better accomplished on an extremely large scale. Most pastures in Nebraska are not large enough for even distribution and adequate rest periods between grazing events to occur.

Therefore, some type of grazing system is necessary for proper grazing management when utilizing bison. Many considerations must be taken into account when designing the system or systems to be used. Items to consider before planning a grazing system with bison include time of rut, time of calving, social groups of the animals involved, areas of the pastures preferred during different times of the year, and other herd behaviors.

Because these factors have a strong influence on how easily the herd will move, along with the disruptions that may cause breeding to stop or abortions of fetus, it may be difficult to plan a rotational system in the same manner that one is planned for cattle. Assistance from the producer in identifying these times and developing solutions to best avoid stress to the animal is important. As with any grazing system, the plan chosen should be dependent on the goals of the producer.

In designing a grazing system, attention should also be given to the type of fencing, location of watering facilities, and the amount of water storage available. Many times, bison have a high respect for any type of fencing. If bison are in adjoining pastures, one herd may try to join with the other herd. Once the animals make up their mind that they want in with the other herd, practically no fence will keep them apart. Interior (or cross) fences should be designed to allow for the herd dynamics to be interrupted the least. Optimum size of pastures will vary depending on the size of the herd, but generally the larger the pasture can be and still be able to meet the goals of the grazing program the less stressful it will be to the animal.

Because of the impact of the lead animal in the herd, not only is water storage important when determining locations and sizes of tanks, but so is the amount of drinking area. It is important to have a tank large enough for as many bison as possible to drink from at one time. It is also important to have it low enough to the ground for the calves. Surface drinking area is critical for the watering location because once the lead cow leaves the area, all other bison will follow even if the others did not get to drink.

Summary

Additional challenges occur with bison than with cattle. It is important for the planner to have a good understanding of the herd dynamics, timing of various life cycles, and the resources that the bison will be grazing. The planner must work closely with the bison producer to achieve the goals of the producer, good grazing management while working within the herd structures of bison.

References

Jennings, Dana C. and Judy Hebbring. Buffalo management and marketing. P. 74-79.

Jurgens, Marshall H., 1974. Animal Feeding and Nutrition, Kendall/Hunt Publishing Company.

Miller, Kristin L. and Shane L. Bennett, 2000. Fecal sampling project on a bison ranch in Lincoln County, Nebraska.

Norland, Jack, 1999. Bison pasture and range management for the northern plains. www.ag.ndsu.nodak.edu.

North Dakota Buffalo Association, 2000. Why raise bison? www.ndbuffalo.org

Peden, D.G., G.M. VanDyne, R.W. Rice, and R.M. Hansed, 1973. Trophic ecology of Bison bison L. on shortgrass plains. p. 487-489.

Plumb, Glenn E. and Jerrold L. Dodd, 1994. Foraging ecology of bison and cattle. Rangeland 16(3): 107-109.

Richmond, R.J., R.J. Hudson, and R.J. Christopherson, 1970. Comparison of forage intake and digestibility by American bison, yak, and cattle. Acta Therologia, 22: 231-240.

Sasketchewan Agriculture and Fodd. Basic nutrition of bison. www.agr.gov.sk.ca.

Steinauer, Gerry. Buffalo: the native grazer. NebraskaLand Magazine, July 1999.

VanVuren, Dirk, 1981. Comparative ecology of bison and cattle in the Herny Mountain, Utah. Proceeding of the Wildlife/Livestock Relationships Sypmosia, 2: 449-457.

University of Nebraska Cooperative Extension, 1996. Beef cow basics: nutrition, economics and forage utilization. Lesson 2.

PROVIDING WATER FOR BISON ON PASTURE

Howard Moechnig, State Grazing Specialist
Natural Resources Conservation Service, Minnesota

Introduction

A well managed grazing system for any kind and class of livestock involves some basics. The most important of these is to manage the grass for optimum growth and regrowth, paying attention to the needs of the forage plants so that they may produce feed for the animals. This involves knowing when to initiate grazing, when to terminate grazing by moving the livestock to new forages, how to deal with very wet or very dry conditions, and how to manage the forages in the fall.

Properly managed forages depend upon fences to partition the pasture into paddocks and to control the movement and placement of the livestock, and a watering system to provide for their water requirements while they are contained in their paddocks.

The importance of the livestock watering system cannot be overstated. This one item will "make or break" the grazing system. What makes a well planned water system so important to a grazing system? Consider the following:

- Animals are sensitive to a lack of water in their diet. If water intake is limited, feed intake is reduced and animal performance is affected.
- If livestock have to travel out of their paddock to water, they are likely to spend longer periods of time at the "water hole", reducing the time they should be grazing.
- If water is not well distributed to the grazing area, livestock will tend to overutilize the forages near the watering facilities, and underutilize the forages farther away from the tanks.
- When livestock have to trail long distances to water much of the manure is dropped on the way to the water and while they are at the water trough, instead of on the pasture where it will provide a benefit to the forages.
- Water is essential for proper operation of the bodily functions of an animal.
- Water acts as a coolant, moderating the body temperature of the livestock.
- Clean water can reduce the risk of disease.
- Reduce trailing and erosion of trails.

We will consider the source of water, the quality of the water, and the quantity required. We will also consider the physical aspects of the system: the pumps, pipelines, and watering facilities.

The content of this article is intentionally general in nature. It is important to evaluate each site or system as it presents itself. Each livestock watering system has its own unique circumstances that must be considered.

Water Sources, Quality, And Quantity

The most commonly used sources of water for livestock are wells, open surface ponds, and flowing streams.

Wells generally provide the best quality of water. However, there are some factors that may prevent use of a well. Some underground water contains high levels of salts or other chemicals that reduce the desirability of the water, which will ultimately reduce the performance of the livestock. Another factor that may make a well inadequate is that some wells do not have the capacity, or yield, to sustain the numbers of animals that must be watered.

Open surface ponds, natural or constructed, are a relatively inexpensive way to provide water. Limitations include poor water quality, especially during the heat of the summer. Diseases and parasites are more prevalent in systems that depend upon standing surface sources of water. An example of this is the presence of liver flukes in open standing natural water sources in northern Minnesota. Another drawback to open natural sources of water is the tendency to dry up during times when the livestock need the water most.

Flowing water sources, such as streams, are commonly used for watering livestock. The quality of the water can be highly variable, especially in streams with contributing watersheds that contain significant areas of annually tilled cropland. Some streams are a dependable source of water, while others will dry up when the

water is needed most. Management of the stream is very important to protect water quality. Generally the livestock are either rotated through the stream corridor as they move from paddock to paddock, or they are provided with an access point to the water. In some cases water is pumped from the stream into a watering facility to prevent the impact of the livestock on the streambanks.

Significant water quality issues that have not been addressed include pH, sediments, algae, and salts. Consideration needs to be given to issues related to corrosion of fittings and parts of pumps, pipelines, and watering facilities. Sediments and algae can plug system components or can render pumps and valves inoperative. Careful selection of pumps and valves is important in these cases, or methods of filtering the water may need to be incorporated into the system.

How much water do bison need each day? In Minnesota we predict that they will need approximately 15 gallons of water for every 1000 pounds of herd weight during normal midsummer conditions. For example, 50 bison cows, each approximately 1000 pound, will have a total herd weight of 50,000 pounds. At 15 gallons per 1000 pounds of herd weight, this herd will need approximately 750 gallons of water per day. The source of water selected for this herd must be able to yield this quantity of water during the hot part of the grazing season.

This water requirement varies with the season. Cool season grasses in the spring contain significant quantities of water (70-90%). Consumption of free water is lower during the spring. As the grazing season progresses, the water content in plants decreases. On native rangelands, the warm season grasses that dominate in the summer generally do not have the high water content that cool season grasses have in the spring, so water is important on native rangelands.

PUMPS

Most systems require some kind of pump to push the water to a destination. The goal is to install a pump that is reliable and as maintenance free as possible. The majority of systems can utilize submersible pumps in wells. If available, this is the easiest and most dependable method, especially if the pump is hooked into a steady source of electrical power.

Some situations demand that an alternative be used because they are not near a steady power source. Alternative pumps have to be judged against the amount of water they will deliver in a given period of time, the reliability of the pump, and the driving force for the pump. The following types of pumps will work for bison:

Solar Powered Pumps: These come in a variety of configurations, from simple pumps that move water whenever the sun shines to battery powered pumps that will pump water on demand. Simple systems can be designed that move water a short distance to a watering facility to those systems that move pressurized water for long distances and over rugged terrain. The cost of these varies greatly and can easily exceed $10,000 for complex systems.

Hydraulic Ram Pumps: These pumps are pertinent where they can be placed at a point lower than the source of water. They work particularly well with springs. They operate on the flow and fall of water. In the right setting they will operate continuously, delivering a steady supply of water.

Sling Pumps: Sling pumps are used in flowing streams. Propeller shaped blades cause the pump to rotate, forcing the water through the coil of pipe inside the cylinder and through the outlet. It takes a fairly good stream to power these pumps.

Gasoline Powered Pumps: Gasoline powered pumps can push large quantities of water for long distances. They are not continuous and require an operator to start them and shut them down. They work well where somebody is checking the livestock on a regular basis and can tend to the pump at that time as well.

The application of these pumps to individual situations and individual sites is important. The distance the water needs to be pumped, the elevations that must be traversed, and the daily water requirements, and the availability of water storage all need to be taken into account when designing the watering system.

Pipelines

Pipelines are required in most systems to deliver the water from the source to the watering facility, or, in the case of alternative pumps, from the source to the storage tank and then to the watering facilities. By far, the most common livestock watering systems in Minnesota consist of a pipeline connected to a hydrant at the farmstead. A submersible pump in a well supplies the pressure exerted to push the water through the pipeline.

Pipelines that are used through the year need to be protected from freezing and are buried below the predicted frost depth. Pipelines used on a seasonal basis can be installed on top of the ground, usually

following a fence line. In situations where grazing is extended in to the late fall, the pipelines are buried shallow, from 1-2 feet deep. While this will not protect the pipeline through the winter, it will protect it through most of the fall and into early winter in some cases.

Most pipelines installed in pastures are high density polyethylene (HDPE). The manufacturers claim that these materials will stand freezing and thawing with water in the pipe. This may be so for a few times, but I have observed these pipe materials with longitudinal cracks from freezing. Another consideration is that the fittings installed in the line will usually not stand up to the same torture that the pipe will, since they are made of other materials. It is important to drain the pipelines to prevent damage from freezing of water in the lines.

Other materials for pipelines may be used, but are usually more expensive, more difficult to install, or reserved for very high pressure situations. Some options include steel or polyvinyl chloride (PVC).

The size of the pipeline that is required for a system is dependent upon how much water is needed, how fast it must be delivered, and the pressure losses due to friction in the pipe itself and the elevation that the water must be delivered to. In any case, installing pipelines less than one inch diameter is not recommended because of the friction losses. In addition, the cost difference between smaller pipe and one inch pipe is minimal. The small extra cost is easily offset by the enhanced capacity of the larger pipeline.

Nearly all alternative pumps need to deliver water to a storage tank, from which the water is distributed to watering facilities, usually by gravitational flow. In Minnesota we feel that a three day requirement should be stored to allow for periods of time when the pumps are not functioning. This will vary by region of the country.

Fittings:

Common fittings used in pipelines include double check valves at the hydrant to prevent back siphoning of the water from the pipeline into the farmstead system, tee's, elbows, air release valves, and drains.

Air release valves are required at high elevations in the pipeline to allow air to escape from the system. Drains are required to allow purging of the system in the fall prior to freezing.

Insert fittings are commonly used for connecting pipelines. With this system the fittings are forced inside the pipe and are secured in place with hose clamps. Another type commonly used is compression style fittings. Both types are satisfactory when installed properly.

Adjusting for Friction Losses:

Friction in the pipeline reduces the delivery rate. Four factors that influence the friction losses are the material the pipe is produced from, the pipe diameter, pipe length, and the flow rate in the pipe. The effects of each are:

- The rougher the material is, the greater is the friction loss.
- The smaller the pipe diameter, the greater is the friction loss.
- The longer the pipeline, the greater is the friction loss.
- The higher the flow rate, the greater is the friction loss.

Tables and charts are available through local Natural Resources Conservation Service offices to determine the friction loss for these factors.

Adjusting for Elevation Differences:

Elevation changes are often the most critical factor in designing the pipeline. It requires 1 psi (pound per square inch) of pressure to push water up 2.31 feet. Most household/farm water systems are set for a minimum pressure of 20 psi, and a maximum pressure of 40 psi. Therefore, with no friction loss considered, the maximum height the system can push water is 46 to 92 feet. When one considers that there should be a 10 psi minimal residual pressure in the pipeline, it becomes clear that from a practical point of view a minimum pressure of 20 psi will actually relate to pushing water up 23 feet in elevation.

It is obvious that in areas where the topography has significant elevation differences the pipeline design can become challenging. Two solutions are commonly used to overcome this.

One option is to increase the operating pressure of the system. Some common settings are 30/50 psi and 40/60 psi. The other common option is to pipe water from the farm system to a nurse tank. From the nurse tank, a separate pump and pressure tank is used to push water out to tanks in the paddocks. This allows the use of increased pressures (commonly up to 70 psi) to overcome elevation obstacles, and even friction losses, or to increase the delivery rate.

While pumping water uphill reduces pressure and delivery rate, water moving down in elevation will produce the opposite effect and pressures will increase. In some cases pressure reducing valves are required to

maintain proper pressures in the pipeline and to allow floats in the water tanks to operate properly. Most valves on the market for installation in livestock water tanks are not meant for pressures higher than 90 psi, and it is preferable to keep the pressure at the tank below 50 psi.

Watering Facilities

Bison require watering facilities that will stand up to rough use. This is especially true when herds are larger and there is more animal pressure at the tank. They must be set in a manner that will prevent the bison from moving them around, risking the breakage of pipelines feeding the tank.

Tanks made from old equipment tires have proven to be successful in bison operations. Tanks made from steel plate have also been used. Fiberglass or tanks made from composite materials may work, however may not be as durable.

In determining how large the tank has to be one must consider the question: "Will the livestock come to water as small groups or as one herd?" In general, a large herd requires a large tank. A small herd can get by with a smaller tank. If the paddock is sized to allow the livestock to always keep in relatively close view of each other, they will likely come to drink in pairs or small groups, and a smaller tank will serve the purpose, one that would contain 25-35% of the daily water requirement for the herd. If they cannot see each other at all times on the paddock, usually due to topography or wooded areas, they will likely come to drink as a herd. In this case the tank should hold at least one half of the daily water requirement for the herd.

Water tanks that contain over 50% of the daily herd requirement can be resupplied in a twelve hour period of time. In situations where the water delivery rate is slow it may be advantageous, or even necessary, to install large tanks.

Some protection of the area around the tank is generally required to prevent the formation of mudholes, and to keep the tank from settling and breaking water line connections.

Placement of tanks in the pasture is important. Each paddock should have direct access to a watering facility, located in a manner that will promote the uniform grazing of the forages. Another consideration is to place the tanks in locations where the risk of erosion of the soil around it is minimal. I always try to locate watering facilities in places that allow for dividing the paddock into two or three paddocks and still get uniform grazing of the forages. Bison will generally be able to uniformly graze forages within 1300 to1500 feet of the watering facility.

Conclusion

Livestock water is important, and in most cases it is essential, to the proper management of the forages in a pasture. It is also very important to the herd health and livestock performance. Assistance for design and installation is available from private companies that sell equipment and form the USDA Natural Resources Conservation Service. NRCS's natural resources conservation programs help people reduce soil erosion, enhance water supplies, improve water quality, increase wildlife habitat, and reduce damages caused by floods and other natural disasters. For more information see their web site: www.nrcs.usda.gov/programs.

In planning a livestock watering system, one needs to consider cost of installation and maintenance of the various alternatives. It may pay in the long term to pipe water for fairly long distances rather than use water of questionable quality. On the other hand, it is better to have poor quality water than no water available at all.

Editors Note: As of this printing, Howard Moechnig will be retired from his position with the NRCS. We would like to thank him for his editorial support in this and past issues of Bison World offering our members a variety of 'Grass Root' management practices.