SDSU Extension

BEEF

Chapter 50

Planned Grazing

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Introduction

All grazing management decisions are based on some sort of plan to achieve a certain set of objectives, whether they are articulated well or not. Even the simplest grazing system, like season-long continuous grazing, may be a product of a plan by a producer who doesn't have the time, resources, or feasibility to carry out a more complicated grazing rotation or simply is interested in achieving high individual animal gain (Briske et al. 2008). The term "Planned Grazing" is more connotative of a holistic view of rotational grazing and may not only involve the production of meat, milk, or wool, but also strive to improve soil health, plant species composition and structure, water quality, and habitat for wildlife. Managers using this conceptual framework are thinking ecologically about the whole system and how it functions (i.e., water and nutrient cycling and energy flow).

The objective of this chapter is to present the principles of planned grazing. This will include 1) a description of rangeland/pastureland ecosystem processes, 2) how these processes are monitored, 3) examples of grazing management decisions directed at ecosystem processes to obtain desired outcomes, and 4) case studies of South Dakota producers. Planned grazing is not a "cookie cutter" or "one size fits all" prescription, but rather a thought process that requires knowledge, skills, and defined goals.

Ecosystem Processes

Grazing lands in general, whether they are native rangeland or tame pasture, provide a way to convert CO_2 into cellulose, which can be consumed by ruminant animals and made available to humans in the form of meat, milk, or wool. Besides these ecosystem goods, grasslands also provide services such as sequestering carbon, providing clean water, and creating habitat for plant and animal biodiversity.

Two main ecosystem processes exist: nutrient cycling and energy flow. Nutrient cycling is the process where nutrients are taken up

Key Points

- Grazing lands in general, whether they are native rangeland or tame pasture, provide a way to convert CO_2 into cellulose, which can be consumed by ruminant animals and made available to humans in the form of meat, milk, or wool.
- How can you make adjustments to your grazing plan if you don't have information to tell you what to change?
- Specific timing and intensity of grazing can improve the performance of your pastures.
- Planned Grazing strives to improve soil health, plant species composition and structure, water quality, and habitat for wildlife.

by plants from the soil, except for carbon which is obtained as a gas from the atmosphere, and are either returned to the soil by decaying plant or animal tissue, evolved back into the atmosphere as a gas, accumulated in litter or roots, taken up by animals into their bodies, lost from the soil by erosion, or leached out of the soil profile. Energy flow describes the process by which energy flows through the ecosystem, and starts with the sun's energy as green plants capture it through photosynthesis and turn CO2 into simple sugars. These sugars are stored energy that is later used as "fuel" when eaten by animals, bacteria, or fungi. Stored energy continues to flow through the food web, to higher trophic levels with less than 1% energy transfer each time it moves up a trophic level because of heat loss during respiration (Briske and Heitschmidt 1991).

Monitoring

In precision agriculture, it is impossible to apply a variable rate fertilizer application without a yield monitoring map and an equipped GPS fertilizer applicator. The same argument can be made regarding grazing management decisions. How can you make adjustments to your grazing plan if you don't have information to tell you what to change? "What gets measured gets done". This old adage fits with any activity, whether it's making a daily work list, keeping track of your pasture moves, or achieving a set of production goals.

Livestock grazing on rangeland and pastureland is a complex process. Livestock interact with climatic (precipitation, temperature, wind), topographic (slope and orientation), edaphic (soil), and biotic (plants and other animals) factors that make up the grazing environment and act as regulators of nutrient cycling and energy flow. In order to reduce the complexity of this system, Orchard (2013) described a simplified model of these processes and the biotic state and combined it with a monitoring program for ranchers to aid in management decisions (Figure 1).

Indicators of these four key areas (Figure 1) can be monitored and plotted over time to help the manager identify management strategies to bring the pasture environment back into optimal ecosystem function. Monitoring tools include 1) soil surveys and maps (Web Soil Survey, Google Earth, etc. See chapter on Ranch mapping for details on these tools), 2) grazing records (keeping track of number of head, grazing dates, grazing index scores), 3) rain gauges (track monthly precipitation and keep a rolling 12-month average, 4) grazing cages (small exclosures used to exclude livestock so that annual forage production and utilization can be estimated), 5) permanent exclosures (recovery pens used to compare several years of no grazing to see if a shift in species composition has occurred), and 6) permanent transects (includes visual estimates, notes, and pictures of indicators described in Figure 1).

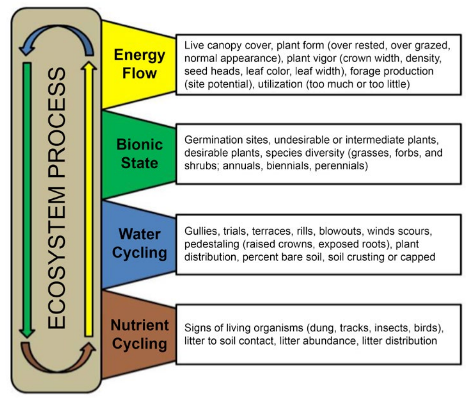

Figure 1: Color coded monitoring indicators of nutrient cycling, water cycling, the biotic state, and energy flow that are involved in ecosystem processes. *Modified after Pyke et al. 2002; Pellant et al. 2005; Orchard 2013.*

Examples of grazing management decisions directed at ecosystem processes Nutrient cycle. How would you know if a pasture is showing signs of an inefficient or poor nutrient cycle? In this case, litter is one of the best indicators. If too much litter is present, it could inhibit tiller density and site productivity because it indirectly limits nitrogen mineralization (Knapp and Seastedt 1986). Sometimes, under these conditions, plants will show yellow or light green color in the leaves because nitrogen is not being mineralized quickly enough. Another sign to look for is low production of seed from perennial plants. Research has shown that removing litter by burning tallgrass prairie is equivalent to fertilizing with nitrogen in producing seed heads of warm-season grasses (Masters et al. 1993). If not enough litter is present (i.e. too much bare ground) biological activity will decrease because soil temperature may become too high and moisture too low from excessive evaporation.

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Setting the correct stocking rate will usually resolve this problem in a few years if the pasture is in a season-long continuous grazing system and it is not too large to cause a grazing distribution problem. In this case, setting the stocking rate to achieve 50% utilization is the optimal target to maintain adequate residual herbage (Smart et al. 2010). If a pasture is in some type of rotation and the litter is too thick, then applying high stock density grazing for a short period in the spring will trample the litter, enhancing soil contact for rapid breakdown. Trampling during summer months can still be effective if precipitation is adequate. However, this usually is not the case as it may take winter snowfall to enhance soil contact for rapid breakdown the following spring. If a pasture is in a rotation and the litter is too low, then a seasonal deferment or a complete year of rest may be enough to provide adequate residual cover to build litter prior to the next growing season. General recommendations of minimum residual herbage levels for shortgrass, midgrass, and tallgrass rangeland should be 300 to 500, 750 to 1,000, and 1,200 to 1,500 lb/acre respectively (Molinar et al. 2001).

Water cycle. How would you know if a pasture is showing signs of an inefficient water cycle? Indicators to evaluate the water cycle include gullies, blowouts, pedestaling, water flow patterns, and amount of litter. Water infiltration is mainly affected by soil texture (size of soil particles; sand, silt, or clay), soil structure (arrangement of soil particles), slope, and vegetation. As managers, we can only control the type and vigor of the vegetation that grows on the land. Vegetation directly impacts the contribution of organic matter (roots and root exudates), which affects microbial activity and soil binding (soil aggregation from microbial gums; Foth 1984). Vegetation and how intensely it is grazed also impacts the amount and type of litter on the surface. Rangeland, either sandy or clay soil types, had lower water infiltration rates from pastures managed with less litter and comprised of shorter species than pastures with more litter and taller species (Rhoades et al. 1964; Rauzi and Hanson 1966).

Changing the amount of litter is probably the most effective management strategy to improve the water cycle. Healing gullies and blowouts using a combination of mechanical renovation and seeding, or feeding livestock hay and allowing them to trample organic matter into the soil will only temporarily fix the problem if the proper amount of litter and residual vegetation is not left at the end of the grazing season (Green 1989; Murray 2003). Setting the correct stocking rate and providing seasonal deferments or an entire year rest will provide vegetation that can be trampled by livestock or knocked down by snow to add litter to the soil surface. Letting vegetation grow tall and mature followed by high stock density grazing is a very useful way to speed up this process. Producers must be careful to monitor animal performance while using this technique because the forage will be mature and low in forage quality. Long-term management toward more diverse mid- to tallgrass species is the best strategy to ensure an effective water cycle. Rangelands that have mid- to tallgrass species produce more biomass and litter and have higher infiltration rates (Rhoades et al. 1964; Rauzi and Hanson 1966; Thurow et al. 1988).

Biotic state. The health of the biotic state is probably the easiest to observe, but might be the most difficult to change, especially in the short-term. The most obvious things to look for are the proportion of desirable and undesirable plants and general species diversity. The Natural Resources Conservation Service (NRCS) has a list of species and their expected proportion for every ecological site. This information can be accessed through the Web Soil Survey (http://websoilsurvey.nrcs.usda.gov/app/) for any location in the USA. Each ecological site contains a description of the possible plant communities with their associated species composition, annual production, and plant growth curve. In addition, a description of transitions leading to other plant communities is given.

Timing and intensity of grazing leads to predictable changes in the plant community composition, and understanding these processes will be helpful in making management decisions that lead to desirable plant community outcomes. For example, in western South Dakota on thin upland ecological sites, a plant community that has had a history of moderate grazing could be dominated by western wheatgrass, buffalograss, and blue grama. This plant community can be shifted toward a more productive diverse community dominated by western wheatgrass, needlegrasses, sideoats grama, and bluestems through seasonal deferments, and/or short grazing periods with long recovery periods, no-use for 1 or 2 years, or light stocking. Because the desired plant community consists of both cool- and warm-season species, a grazing period or deferment directed toward one specific season (cool or warm) may not achieve the desired outcome. A complete rest or a shift in season of use toward the dormant season (winter) may be necessary. Semi-permanent recovery pens (3 to 5 years) are excellent tools to observe if a change inside the protected pen differs from the grazed pasture. If a positive change occurs inside the protected pen, then the rest period of the current grazing practice is not long enough for plant recovery or the timing of the grazing period is damaging the desired species. If a complete year rest is not economically feasible, consider switching the season of use to the dormant season.

Energy flow. Energy flow is most easily identified by the amount of green vegetation produced on an annual basis. Historical stocking rate studies show that herbage produced on rangeland is ranked from highest to lowest in light, moderate, and heavy stocked pastures, respectively (Smart et al. 2010). From a livestock production perspective, we want an efficient yet sustainable energy flow (i.e., products of photosynthesis consumed by livestock to produce meat, milk, or wool without degrading the ecosystem). Light stocking may produce more herbage, but only 14% is consumed by livestock compared to moderate stocking (24%) and heavy stocking (38%) (Smart et al. 2010). A moderate stocking rate results in optimum energy flow (balance between herbage consumed by livestock and residual herbage left to protect the environment); whereas, a heavy stocking rate is more efficient at converting herbage to livestock products, but causes degradation to the environment (Smart et al. 2010).

Grazing exclosures are the most useful tool to estimate annual production and utilization of pastures. Clipping or visual estimates from inside and outside of exclosures can be compared to determine how much forage was produced and how much was utilized. If the pasture is not producing enough herbage compared to its potential, it means that the species composition consists of low producing species or is not efficiently capturing the sun's energy and likely losing water to evaporation and runoff. To correct this, the manager would have to evaluate the potential plant communities with this ecological site and use the strategies mentioned in the biotic state discussion to make appropriate changes. If the utilization (difference between inside and outside forage mass measurements of exclosures) indicates light or heavy use, utilization can simply be corrected by keeping track of grazing records and making stocking rate adjustments accordingly in following years.

Case Studies

Forty Bar Ranch

Located along the Missouri River north of Iona, SD, the Forty Bar Ranch, owned by Warren Hammerbeck, is a picturesque ranch that uses a sophisticated grazing plan to improve the native grass species and wildlife habitat while making a profit from livestock production. The ranch consists of steep rolling hills, creek bottoms, and flat uplands. The dominant ecological sites are shallow clay, clayey, dense clay, thin upland, and thin claypan. The ranch receives roughly 22 inches of annual precipitation and supports a diverse mixture of native cool- and warm-season grasses, forbs, shrubs, and trees. Introduced cool-season grasses, such as Kentucky bluegrass, smooth bromegrass, and crested wheatgrass, are also present. The ranch runs a combination of 600-700 yearlings and 300-350 cow-calf pairs on roughly 5500 acres. For the last 12 years, Hammerbeck has been implementing a unique grazing system that combines his "five-season rule" with four grazing intensity categories (light, moderate, heavy, and intense). The "five season rule" means that once a pasture is grazed for a season (typically for two to four months) it will not be grazed for four more seasons (spring, summer, fall, and winter). This means that the ranch has a shifting mosaic of landscapes that receives light to intense grazing at different times of the year. Cattle performance is adequately maintained because cattle are always being moved to a new pasture with high biomass comprised of diverse cool- and warm-season grasses and forbs. This sophisticated grazing system takes a lot of planning and requires careful record keeping; planning the appropriate grazing seasons and intensities in future years. Monitoring has revealed that this strategy is working to improve the composition of more desirable and productive native grass species, reduce introduced cool-season grasses, and provide diversity in wildlife habitats (Fig 2.).

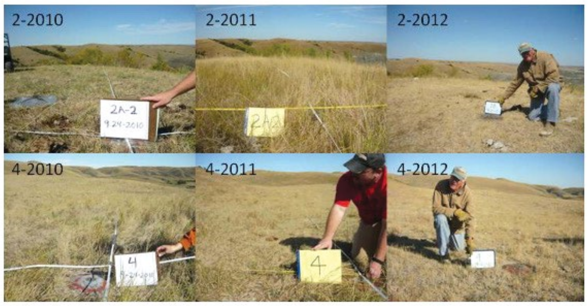

Figure 2: Photo points of pasture 2 in 2010 (top left), 2011 (top middle), 2012 (top right), and pasture 4 in 2010 (bottom left), 2011 (bottom middle), and 2012 (bottom right) on Forty Bar Ranch. Pasture 2 was grazed intensely in summer 2010, rested in 2011, and grazed heavily in 2012. Pasture 4 was lightly grazed in spring 2010, heavily grazed in summer 2011, and moderately grazed in spring 2012. *Photo by A. Smart.*

Warren Hammerbeck has seen increases in white tailed deer and sharp tailed grouse populations in the last decade. Pheasant numbers have stayed the same. Warren believes that this planned grazing rotation is more in line with how the buffalo grazed these grasses. He has increased carrying capacity 30% over the previous season-long continuous grazing method using the "take half leave half" stocking rate. This has taken about 10 years and is a result of improved grazing distribution and harvest efficiency. His long-term goal is to double the carrying capacity of the ranch.

Totton Angus

Located north of Chamberlain, SD, on the eastern side of the Missouri River, Totton Angus is operated by Charlie Totton. He uses a combination of winter grazing, flash spring grazing, rotational grazing, and mob grazing. Charlie runs 200 cow-calf pairs on gently rolling topography made up of predominately loamy, clayey, thin upland, and very shallow ecological sites. The ranch receives about 22 inches of annual precipitation. Charlie began intensifying his grazing on a section of native prairie in 2008. This piece of land was convenient because of its close proximity to his headquarters, the gentle rolling topography, good soils, and current infrastructure (water and fencing). His unique grazing plan includes splitting the section in half and rotating the two pastures between summer and winter grazing (Fig. 3). In the spring, the pasture designated for mob grazing gets "flashed" grazed to utilize the introduced cool-season species (Kentucky bluegrass, smooth bromegrass, and crested wheatgrass). This grazing technique uses a rapid rotation (2 weeks) through the pasture in late April or early May, with careful attention not to over utilize the growing forage that will be stockpiled for mob grazing.

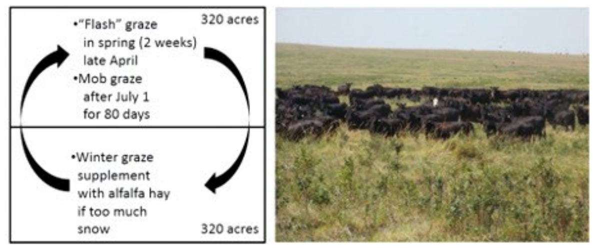

Figure 3: Section of land (left) is split between "flash" grazing in spring followed by summer mob grazing and winter grazing. Each year the season of use is switched between the two pastures (arrows). On the right is a picture of cattle mob grazing in July 2012. *Photo by A. Smart*

In early July, the cattle are moved back to the half-section that was flashed grazed earlier in the spring to begin mob grazing. Totton uses a stocking density of approximately 75,000 lbs of live beef per acre and moves the cattle once per day (200 cow-calf pair on four acres). Charlie does not back fence the mob grazed paddocks, thus cattle can access permanently located water tanks (located in the center of each 320 acre pasture). The maximum time cattle have access to previously grazed paddocks is 20 days, preventing the cattle from grazing regrowth. The other pasture receives a full growing season deferment to stockpile native grass (wheatgrass, needlegrass, and bluestem) for winter grazing. The season of use between the two half sections are switched each year. During other months, when the herd is not grazing this section of land, Totton switches to a more traditional rotation, moving cattle about once a month with much lower stocking densities. These other pastures are on much rougher topography, poorer soils, and pose significant challenges to adding crossfence and developing watering sites.

This grazing plan requires monitoring species composition, utilization, trampled litter, and cow body condition. Totton's goal is to increase soil health, plant production, and harvest efficiency using this unique combination of flash grazing, mob grazing, and winter grazing. This section of land provides roughly 2.3 AUM/acre (200 cow-calf pair weighing 1500 lbs each grazing for 5 months on 640 acres), which is about 3 times the initial suggested stocking rate for a loamy ecological site grazed season-long continuously (USDA-NRCS 2006).

The reason that this system is more efficient is because part of the use is split between the dormant season (winter grazing) and the growing season. The pasture that was mob grazed the previous year receives a growing season deferment the following year. In addition, the forage is fairly mature by the time the cattle mob graze in the summer. Thus, higher utilization (>80%) does not cause a negative shift in species composition that would be expected under season-long continuous grazing.

Rasmussen-Lehman 33 Ranch

Located near Cedar Butte, SD on the edge of the Badlands is the Rasmussen-Lehman 33 Ranch which is owned and operated by Dan Rasmussen and Blake Lehman. Rasmussen has been refining his rotational grazing plan since the 1980s. His grazing philosophy is to have the cattle graze certain plants at a specified time of year that maximizes their use of that species, which extends the grazing season, and reduces the need to feed supplemental hay. This type of grazing system is called "seasonal suitability" (Holechek and Herbel 1982).

Maintaining maximum diversity is an extremely important goal for the Rasmussen-Lehman 33 Ranch. In order to accomplish this, the owners have spent considerable time learning when during the year different grasses and forbs are palatable to cattle. For example, warm-season grasses such as big bluestem, little bluestem, and sideoats grama are very palatable in the summer but are not in the winter. Western wheatgrass, which is relatively palatable year round, is more beneficial from their perspective to be grazed in the winter. Annual bromegrass typically greens up in the fall (depending on fall moisture), over winters, and re-greens up in April and stays green until seed set in late May. The ranch incorporates flash grazing in late April to capitalize on annual bromegrass's narrow window of palatability. Once the cattle switch to grazing western wheatgrass, they are moved to another pasture to save the western wheatgrass for winter. If annual bromegrass does green up in the fall, it tends to remain palatable through early winter and can increase diet quality of grazing livestock (Holechek 1984).

The ranch has no particular set order for grazing pastures, and the owners have separate winter and summer pastures. These designations are not based on plant community types but more indicative of characteristics for protection during winter storms and convenience to access from the ranch headquarters. Even though separate winter and summer pastures are used, it does not mean that these pastures should only be grazed in those seasons. For the reasons mentioned previously, it would be good practice to take advantage of the palatability "window" certain species have regardless of of where pastures are located. This type of grazing plan requires a high degree of knowledge and skill from the ranch manager to identify the "window" of opportunity to graze certain species at the right time and apply the grazing without making mistakes (i.e., overgraze non-targeted plants).

This grazing plan requires annual monitoring, so that the ranch manager can evaluate trends in range condition. The payoff of this type of grazing plan comes from the increased grazing efficiency (i.e. translates to higher stocking rate) over traditional season-long continuous grazing.

Figure 4: Dan Rasmussen and Blake Lehman oversee a group of SDSU range management students collecting plant species composition at one of their long-term monitoring sites. *Photo by A. Smart, 2005*

Summary

This chapter introduced the concept of "planned grazing" and described how it incorporates knowledge of pastureland ecosystem processes. Understanding how to monitor pastureland ecosystem processes is key to making informed management decisions and is part of the planning process. This chapter showed that planned grazing is not a "cookie cutter" or "one size fits all" prescription, as evident by the specific case studies presented. It was clear that all 3 case studies used planned grazing as a way to increase the harvest efficiency of their forage resources, which has resulted in an increased carrying capacity on their ranches.

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