WASHINGTON STATE UNIVERSITY

Central Washington Animal Agriculture Team

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Optimizing Pasture and Animal Production through Planned Grazing

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Over the past twenty years, my life has largely been devoted to pasture and grazing research, as well as maintaining an active daily involvement in commercial cattle and sheep production. In that time, I have found there are a few key principles of grazing systems management that are critical to success across a wide range of environments and enterprises. Those principles are appropriate and variable stocking rates, maintaining forage intake, appropriate post-grazing residual, balanced rest and use, and maintaining a pasture rotation. I would like to explore each of those in this presentation.

APPROPRIATE STOCKING RATE

Stocking rate is the number of animals or amount of grazing pressure we place on the grassland resource. Because each animal needs to eat a particular quantity of grass every day and an acre of land has only so much capacity to capture solar energy and grow grass, there is a pretty definite relationship between stocking rate, animal performance, and land quality. Carrying capacity is the appropriate stocking rate that maintains animal performance and land condition at acceptable levels. Because forage productivity is not constant throughout the year, stocking rate cannot be held constant on a year-around basis without supplemental feeding.

While we often think of stocking rate in terms of animal days or animal months or just plain animals per acre, it is really forage demand we are concerned with. There are several ways of varying animal demand for forage. The most obvious is to change animal numbers and thereby increase or decrease forage demand. This is not always practical to do nor economically feasible. The way I have accomplished this over the years on our own ranch is to maintain a base cow herd on a year-around basis and then use contracted animals during periods of excess pasture growth. The base stocking level is the number of animals I can maintain over the winter on stockpiled forage with minimal hay supplementation. Most people immediately think of growing steers as contract animals, but there are many other options that can offer even more management flexibility than steers. On our operation we have run steers, beef replacement heifers, dry fall calving cows, spring cow-calf pairs, as well as horses. Anything that will eat grass and someone will pay you to maintain can be used as contract grazers. Dry fall cows is my favorite because they offer the greatest spring and

summer pasture management opportunities due to their low nutrient requirements.

The best way to determine the appropriate stocking rate is through years of experience on a particular piece of pasture. We don't always have the luxury, nor can we afford that level of education. There is a basic relationship between pasture and animal factors that can be used to estimate appropriate stocking rate using this formula:

Carrying Capacity =
(Forage Production X Seasonal Utilization)
÷
(Intake X Length of Grazing Season)

Forage production is the annual forage dry matter yield and is expressed as lb forage/acre. Forage production can be affected through management practices such as fertilization, interseeding, and planned grazing, as well as stocking rate itself.

Seasonal utilization rate represents the percentage of the annual forage production that is actually consumed by the grazing animal. Two primary factors determine utilization, length of the grazing period and spatial grazing distribution. As grazing periods become longer, more forage is wasted due to manure fouling and camping. Shorter grazing periods (ie. less than 4 days) can significantly increase seasonal utilization rate. Research from many different forage systems around the world indicates that 35 to 50% of forage grown in a season is actually consumed by the grazing livestock in a continuous grazing situation. Missouri research has shown seasonal utilization rate on tame pastures can be increased to 65 to 70% with grazing periods of 3-4 days and up to 85 to 90% when grazing periods are less than two days. In rangeland environments, annual utilization rate should usually be kept to less than 60%. As travel distance to water increase beyond a quarter to half mile, depending on environment, grazing efficiency begins to decline.

Intake is daily forage requirement expressed as percent of bodyweight or pounds of forage per pound of animal live weight. The range is typically from about 2% for maintenance up to 4% for first calf heifers in low body condition. Length of the grazing season is how many days that pasture is expected to feed the herd.

Using reasonable estimates in the formula, tempered with good judgment, can give a fairly accurate estimate of the pounds of animal live weight each acre can be expected to support. The importance of stocking rate is further illustrated in the next section on managing forage intake.

INTAKE

A very basic objective of grazing management is to ensure grazing animals receive adequate nutrient intake to achieve the performance targets we set for them. Whether we are talking about lactating dairy cows, growing beef stockers, or finishing lambs on pasture, a given level of performance requires a given level of energy, protein, and other nutrients. Just because the stock are standing in a pretty, green pasture does not necessarily mean those needs are being met. To achieve a target production level, a defined quantity of calories must be consumed. For example, a 700-pound heifer with a 1.75 lb/day target rate of gain would require approximately 12.4 Mcal/day. If she consumes less than that amount, she will not reach her target weight on time. Her energy intake is controlled by the combination of weight of dry matter forage consumed and the energy density of that forage. Our challenge as grazing managers is to ensure we provide her the opportunity to reach our performance target.

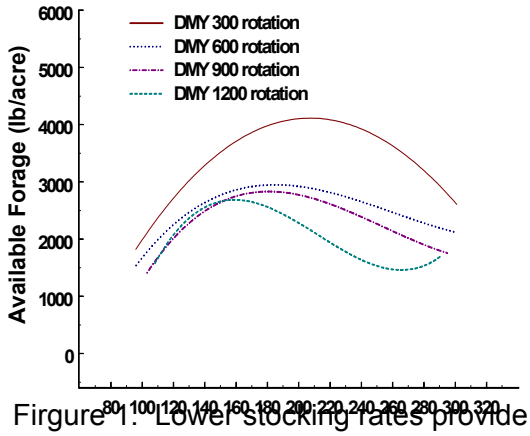
Voluntary forage intake (VFI) by grazing animals is controlled by three factors: time spent grazing, biting rate, and bite size. The first two are largely beyond our control. Ruminants divide their days into three activities with roughly the same amount of time spent grazing, ruminating, and resting. With excellent forage conditions, any class of ruminant can meet its physiological needs in as little as four

hours of grazing. In poor pasture conditions, they may extend their grazing time to about ten hours. It is almost impossible for cattle to sustain active grazing any longer than ten hours because of the physiological demands of rumination and rest.

Cattle can vary their biting rate from about 30 bites per minute (bpm) up to 80 bpm, but the high end occurs only on very short pasture where bite size is very small. Increasing bpm is a possible means of compensating for reduced intake due to reduced bite size. Bite size is highly dependent on forage height and density, which are factors we can control with grazing management. When a cow is taking 30 bpm, each bite may be a mouthful. At 80 bpm, she may require 15 to 20 bites to get a mouthful. Increased biting rate will not necessarily allow the animal to maintain an intake level comparable to that achieved on a dense sward where a single bite may produce a mouthful.

The effects of grazing management on forage availability and quality are highly dependent on stocking rate (Figures 1 & 2). These two figures illustrate the impact of increasing stocking rate from 300 to 1200 pounds of animal liveweight per acre on both forage availability and quality. Increasing grazing pressure results in lower forage availability but usually produces higher quality pasture. The challenge for the grazing manager is determining the appropriate balance of availability and quality to meet a particular production target.

Rate of gain by steers grazing these pastures declined linearly from highest to lowest stocking rate implying that forage availability was more important in determining steer performance than was forage quality. Intake was estimated in this study by comparing available forage before and after each grazing period and was found to decline linearly as forage availability declined. There was no correlation at any point in the season between measurements of forage quality and estimated intake. These pastures were intensively managed with cattle shifted to a new paddock every one to three days. With medium-length rotations (five to ten days), forage quality has more influence on forage intake due to highly selective grazing early in the grazing period while selectivity becomes limited late in the grazing period. With long rotations and continuous grazing, new regrowth provide high quality forage to grazing animals later in the grazing period. Selective grazing is very important for maintaining intake in traditional rotational grazing and continuous grazing. While average forage quality may not appear to be adequate, ability of the animal to select high quality material allows the animal to maintain an intake level higher than would be expected based on bulk forage quality.



Firgure 1. Lower stocking rates provide greater forage availability compared to high stocking rates

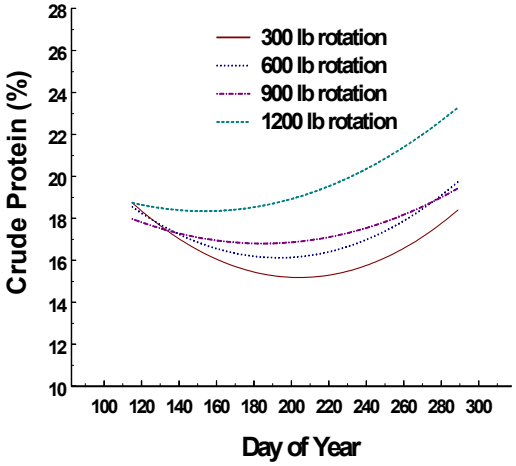


Figure 2. Higher stocking rates produce higher quality forage compared to low stocking rates throughout the grazing season.

RESIDUAL

The amount of forage remaining in the pasture after grazing is generally referred to as the residual. While most graziers refer to all plant material left after grazing as residual, green leaf residual is the really key consideration. While residual is really a leaf area requirement, we often think of it in terms of height. Residual affects a number of plant, soil, and animal factors in the grazing ecosystem.

After grazing, the residual green leaf is the factory for generating regrowth. For many species, particularly grasses, regrowth rate is directly correlated with residual leaf area. We often speak of carbohydrate root reserves as being the source of energy for plant regrowth after grazing. Root reserves are very important for alfalfa, some other legumes, and rhizomatous grasses. Location of leaves relative to grazing height dictate the plant's level of dependency on residual for regrowth (Figure 3). Tall fescue with high leaf density low in the canopy requires less residual than does smooth bromegrass with low leaf density. Maximum regrowth of tall fescue occurs at about 1500 lb/acre residual. Above this level dead leaf accumulation slows regrowth rate. Erect growing species such as smooth bromegrass and the tall native grass species respond directly to increasing residual.

On the other end of the plant, root growth and survival is closely tied to residual leaf area. Most graziers have seen the first two columns of data in Table 1, originally attributed to F.J. Crider and published in 1955. This is generally accepted as gospel to the extent that this same table can be found associated with tree pruning recommendations, lawn care in Australia, and all kinds of pasture in the US. Interestingly, this data which appears in so many grazing documents actually reports the response of Rhodes grass, a non-native warm-season species with little use in North America to a single clipping at multiple levels of defoliation. Crider conducted another study with repeated defoliation of Rhodes grass, Kentucky bluegrass and smooth bromegrass, the results of which are shown in the three following columns of Table 1.

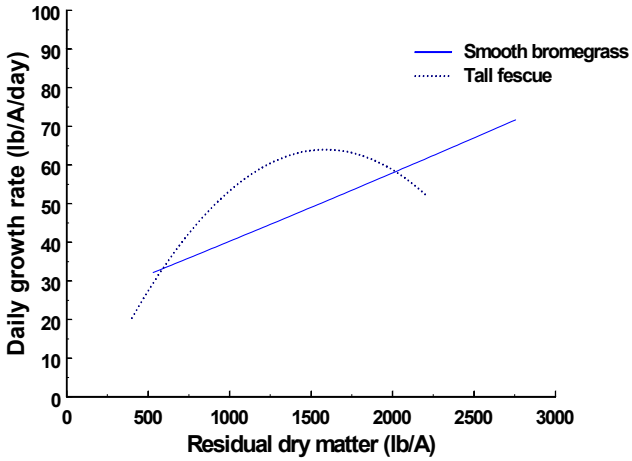


Figure 3. Pasture daily growth rate increases as more residual forage is left after grazing.

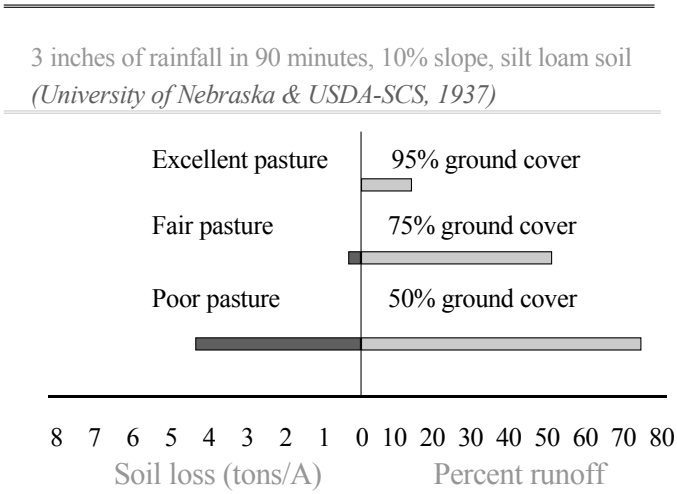
The repeated defoliation impact at 50% utilization is much more severe than the table we have all seen in the past leads us to believe. Crider monitored root growth for 33 days after the defoliation treatments were applied. Even with the single clipping at 50%, it took 17 days for the root system of Rhodes grass to recover. Most graziers get in to the habit of defoliating pastures to the same level in each grazing period. If we once acquire the habit of grazing to 60 or 70% utilization, the pasture falls into a downward spiral. I believe one of the most important grazing rules of all is the old 'take half, leave half' adage. Grazing to 35 or 40% utilization and returning more quickly to pastures may be even superior.

As residual affects both surface ground cover and root mass, it also has a significant impact on soil organic matter, soil compaction, and water cycle. Another classic piece of research conducted in Nebraska in the 1930's illustrates the impact of residual on water infiltration and runoff (Figure 4). In this study, three inches of rain was applied through a sprinkler system in 90 minutes. Pasture grazed for a healthy residual experienced only a little over 10% runoff while the overgrazed pasture lost 75% of the rain falling on that area. Most droughts in the Midwest are created by man, not acts nature.

Table 1. Effect of different degrees of repeated leaf removal on root growth three days after clipping.

Leaf Removal (%)	Rhodes grass (single clipping)	Rhodes Grass	Smooth Bromegrass	Kentucky Bluegrass
		Percentage	Root	Stoppage
10	0	0	0	0
20	0	0	0	0
30	0	0	0	0
40	0	0	0	0
50	2	8	13	38
60	50	80	36	54
70	78	97	76	77
80	100	100	81	91
90	100	100	100	100

Figure 4. Surface vegetation management affects water runoff and soil loss.



REST

We all know that pastures need to be rested to restore CHO storage and plant vigor, but is that all that the rest period provides? As discussed above, many forages rely on residual leaf area for regrowth, not stored CHO. Rest really allows leaves to regrow, which in turn supplies excess CHO for storage and helps maintain vigor and root growth. Determining appropriate rest period length is a challenge graziers face on an ongoing basis. Animal and plant needs must always be balanced. Longer rest periods provide healthier plants and ample forage, but reduced forage quality. Short rest periods supply high quality forage, but may stress plants and leave forage supply short. Changing growing conditions dictate that rest periods may need to be lengthened or shortened. One thing for sure is leaving more residual increases flexibility in rest management while lower residual reduces management flexibility.

Soils that are severely trampled during wet conditions recover their tilth much quicker if animal pressure is removed and plant roots begin to rapidly grow back.

Allowing adequate rest period helps reduce soil compaction. A four year study at FSRC found that soil bulk density tended to be lower for rotationally grazed pastures compared to continuously grazed pastures for low to medium stocking rates. At high stocking rates, compaction was equally severe for both grazing management regimes.

Several environmental and wildlife benefits can be attributed to providing rest periods. The stream bank stability and bird nesting studies conducted in Wisconsin by Paine and Undersander, being good examples. Several studies in the western US have shown notable streambank improvement where planned grazing systems have been implemented. It is the continuous presence of livestock in riparian areas that creates problems, not the occasional use of a site by livestock. Native plant species tend to increase when appropriate rest periods are provided. Appropriateness includes both timing and duration.

The required rest period may be as short as 10 to 15 days in springtime on well-fertilized cool grasses during their peak growth period. The same species may require up to 45 days rest during hotter, drier periods. Rest requirements for tall grass prairie sites may vary from 20 to 60 days depending on growing conditions. In semi-arid rangelands, a single grazing period per year may be all that is appropriate followed by a full year's rest. Rest management cannot be calendar based but must be planned in response to growing conditions and planned use patterns.

ROTATION

The movement of animals from one pasture to another draws the previous concepts together into the management system. The day-to-day management of the rotation determines soil, plant, and animal response to our actions. The previous concepts are the scientific basis of MiG, managing the rotation is the art.