SDSU Extension

BEEF

Chapter 51

Setting the Stocking Rate

Alexander “Sandy” Smart,
Julie Walker and Roger N. Gates

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Introduction

The objective of this chapter is to highlight the importance of setting pasture stocking rate and to present various ways to calculate it based on different information available to the manager.

Definitions

Stocking rate is defined as the number of animal unit months per acre (AUM/acre) that a pasture can support. One animal unit (AU) is equivalent to a 1000 lb cow (with or without a calf up to three months of age). An AU typically consumes about 26 lbs of oven-dry forage per day. Animal unit equivalents (AUE) can be calculated for other classes or species of livestock by simply dividing the animal's weight by 1000. Thus, an AUM can be converted to 780 lbs of oven-dry forage (the amount needed to feed one AU for 30 days). This number will be used in later calculations to set the stocking rate. This conversion will underestimate intake on animals that weigh less than 1000 lbs and overestimate intake on animals that weigh more than 1000 lbs. A more accurate estimate of animal unit equivalents based on forage intake of various livestock classes and species are presented in Table 1.

Efficiencies of Grazing

In order to set the stocking rate, one needs to know how much forage is produced on the pasture and how much forage will be harvested by the livestock. At the same time, producers need to remember that grazing is an inefficient process. Grazing livestock live in their "feed bunk", causing forage to be trampled on and fouled by excretion. In addition, forage losses can occur from wildlife and insects and over time through senescence (dropping of older leaves). Research has shown that the amount of forage lost from these other processes is considerable (Smart et al., 2010). The harvest efficiency (amount of forage consumed by livestock compared with the total forage produced) is about 25%, and another 25% is lost by trampling, fouling, and senescence with moderate stocking rates using a continuous season-long grazing system (Figure 1).

Table 1: Animal unit equivalents.

Animal AU	Equivalent
Cattle	
Mature 1,000 lb cow with or without calf	1.00
Mature 1,100 lb cow with or without calf	1.07
Mature 1,200 lb cow with or without calf	1.13
Mature 1,300 lb cow with or without calf	1.19
Steers and heifers (2 yrs and over)	1.00
Calves (over 3 months)	0.30
Weaned calves to yearling	0.60
Yearling cattle	0.75
Dairy cattle	1.30
Mature bulls	1.30
Sheep	
Mature ewes with or without lambs	0.20
Weaned lambs to yearling	0.12
Mature rams	0.25
Goats	
Mature does with or without kids	0.17
Weaned kid to yearling	0.10
Mature bucks	0.22
Wether	0.16
Other	
Horse, mature	1.50
Deer, white-tailed, mature	0.15
Deer, mule, mature	0.20
Elk, mature	0.60
Antelope, mature	0.20
Bison, mature	1.00
Sheep, bighorn, mature	0.20

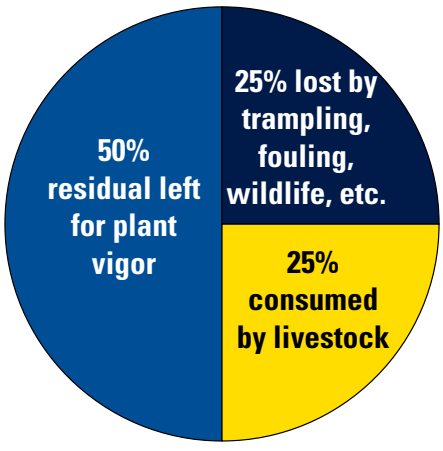

Figure 1: Efficiency of grazing under moderate stocking rates using season-long continuous grazing. Livestock consume 25% of the forage, 25% of the forage is lost due to tramping, wildlife, etc., and 50% is left as residual to maintain plant vigor. Adapted from Smart et al., 2010

Increasing the stocking rate can increase harvest efficiency, but it results in less residual for plant vigor and degradation of the plant and soil resources under season-long continuous grazing (Smart et al., 2010). The benefit of rotational grazing is that the harvest efficiency can be increased without the proportional increases in losses through insect and wildlife damage (Sedivec and Barker, 1991). Harvest efficiencies can be safely set at 30-35% using most rotational grazing strategies. Ultra high stocking density grazing, or "mob grazing", can have harvest efficiencies as high as 50% without causing degradation to vegetation and soils as long as sufficient rest is planned (Smart, unpublished research).

Setting the Stocking Rate

Ideally, the stocking rate for a pasture should be at or near the long-term carrying capacity. Carrying capacity is a stocking rate that does not cause long-term degradation to the pasture resources (vegetation, soils, etc.). The stocking rate is going to be determined by the objectives of the manager. If the sole purpose of the pasture is livestock production, then the stocking rate will most likely be near its maximum carrying capacity (meaning the forage is primarily to be consumed by livestock). However, if a producer has conservation goals or uses the pasture for wildlife production, then the stocking rate will most likely be lower than the maximum carrying capacity (meaning the forage is needed not only for livestock consumption, but also to supply cover for wildlife).

Knowing the desired harvest efficiency and the forage production of the pasture are the two most important pieces of information needed to set the stocking rate. The harvest efficiency can be decided ahead of time based on the goals of the manager. For example, if a producer desires moderate use when implementing a season-long continuous grazing system, the harvest efficiency value should be 25%. If a producer has a rotational grazing system, the harvest efficiency value could be set at 30 or 35% depending on the length of the recovery periods. Forage production of a pasture can be estimated from book values provided by the Natural Resources Conservation Service (NRCS) Web Soil Survey (http://websoilsurvey.nrcs.usda.gov/app/) or be

measured directly in the field. Using book values is a good place to start, but having actual production estimates over several years is more accurate to your ranch.

The actual production method is a way to set the stocking rate based on estimates of total useable forage production.

1. Estimate the total amount of forage per acre
2. Convert green weight to oven-dry weight
3. Convert into animal-unit months

When setting the stocking rate, useable forage production is considered as the current year's forage growth or residual herbage if it was stockpiled from the previous growing season. Forage production that includes undesirable, non-consumed, or toxic plants to the kind and class of livestock intended to graze the area should be excluded. For example, when taking a forage sample, one would not include plants like leafy spurge or thistles in the sample because livestock are not likely to consume those plants. An easy method to measure forage production is to clip all the useable forage from a 93 inch hoop (Figure 2). Multiply the weight in grams of the air-dry sample (minus the bag weight) times 20 and the resulting answer is yield in pounds per acre. For more detailed, step by step instructions, see Chapter 4 in the National Range and Pasture Handbook by NRCS at http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/landuse/rangepasture/?cid=stelprdb1043084.

Figure 2: Forage sampling hoop, 93 inch perimeter (4.8 sq. ft.). Multiply the air-dry forage weight in grams by 20 to convert production to pounds per acre.

Air-dry weight of forage samples can be adjusted to oven-dry weight by assuming air-dry is 12% moisture. Simply multiply air-dry weight by 88% to convert to oven-dry weight. If you don't want to wait to air dry your samples, you can estimate air-dry weight of your fresh clipped forage by using Table 2.

The amount of forage available for consumption is multiplied by the harvest efficiency expected for the

Table 2: Percentage of air-dry matter in fresh clipped grasses and forbs at various growth stages. *Adapted from USDA-NRCS, 2006*

Growth Stage					
Grasses	**Vegetative**	**Headed out**	**Seed ripe**	**Leaves dry**	**Dormant**
% Air Dry Matter					
Cool-season grasses	35	45	60	85	95
Warm-season grasses	30	45	60	85	95
Mid-grasses	40	55	65	90	95
Short grasses	45	60	80	90	95

Forbs	**Vegetative**	**Flowering**	**Seed ripe**	**Dry leaves**	**Dormant**
% Air Dry Matter					
Succulent forbs	15	35	60	90	100
Leafy forbs	20	40	60	90	100

Shrubs	**New leaf and twig growth**	**Older and full size leaves**	**Green fruit**	**Dry fruit**	**-**
% Air Dry Matter					
Evergreen	55	65	35	85	-
Deciduous	35	50	30	85	-

area. This is the amount of forage allocated for the animal's consumption. This amount is then divided by the amount of forage allocated to an AUM (1 AUM = 780 lb oven dry forage). This gives the number of AUMs that the area can safely support from the estimated forage production. To arrive at the total AUMs for that management unit (pasture), the AUMs per acre are multiplied by the number of acres represented by each sample collected.

Stocking Rate Calculation Example:

1. Your pasture yields 2,500 lb/ac of usable forage
   a. 2,500 lb/ac x 0.25 (harvest efficiency) = 625 lb/ac forage consumed
2. Pounds of forage available for consumption Dry Matter Intake for 1 AUM = AUMs/ac
   a. 625 lb/ac ÷ 780 lb/AUM (forage for 1 animal unit for 1 month) = 0.79 AUMs/ac or 1.26 ac/AUM

Adjustments in stocking rates should be considered for areas that are not grazed by livestock because of landscape physical factors, such as difficulty of access due to slope (Table 3) and distance to water (Table 4). The adjustments to reduce stocking rate should be made only for the acreage of pasture with the physical limitations, and will reduce overall animal numbers in the pasture.

Table 3: Adjustments to stocking rate for slope on rangelands.

Percent slope	Percent adjustment
0-15	0
15-30	30
31-60	60
> 60	100

Table 4: Adjustments to stocking rate for water distribution on rangelands.

Distance (miles)	Percent adjustment
0.5 to	1 0
1 to 2	50
2 to 3	75

Carrying capacities have been established for ranges and pastures in South Dakota (Figure 3). These suggested stocking rates are based on soil type and vegetation productivity. These are meant to give a starting point and are conservative.

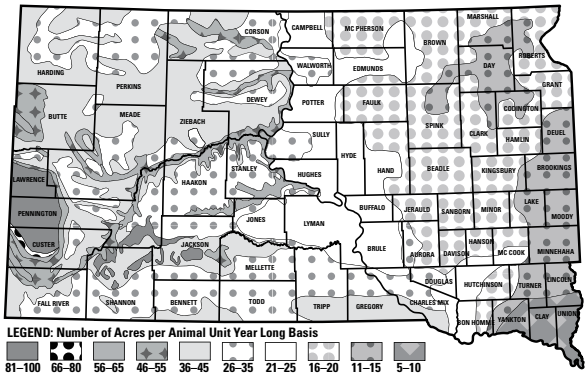

Figure 3: Carrying capacity of ranges and pastures for South Dakota (SDSU, 2007). To convert to AUM/acre, divide by 12, the values listed in the legend.

Summary

Setting the stocking rate is fundamental to grazing management. The stocking rate will influence animal performance, plant composition and productivity, and soil health. Stocking rate decisions are based on harvest efficiencies of different grazing systems and the productivity of the pasture. Setting the stocking rate at or near the long-term carrying capacity is important to optimize beef production, but adjustments should be considered if management of other non-consumptive resources (e.g., wildlife, diversity, etc.) are valued. Book values of productivity are available online as a starting point, but collecting hand clipped usable forage production estimates on your own pastures over multiple years is more accurate.

References

USDA-NRCS. 2006. National Range and Pasture Handbook. Chapter 4: Inventorying and monitoring grazing land resources. 84 pp. Washington, D.C. Available online at: http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1043061.pdf

SDSU. 2007. South Dakota rangeland and pasture grazing records. South Dakota State University, College of Agriculture and Biological Sciences, South Dakota Cooperative Extension Service. Brookings, SD. EC923. 36 pp. https://openprairie.sdstate.edu/extension_circ/487/

Sedivec, K.K., and W.T. Barker. 1991. Design and characteristics of the twice-over rotation grazing system. North Dakota State University Extension Service. Fargo, ND. R-1006. 8 pp.

Smart, A.J., J.D. Derner, J.R. Hendrickson, R.L. Gillen, B.H. Dunn, E.M. Mousel, P.S. Johnson, R.N Gates, K.K. Sedivec, K.R. Harmoney, J.D. Volesky, and K.C. Olson. 2010. Effects of grazing pressure on efficiency of grazing on North American Great Plains Rangelands. Rangeland Ecology and Management 63:397-406.