GRAZIER'S ARITHMETIC

Jim Gerrish & Ron Morrow

INTRODUCTION

Determining the appropriate stocking rate for a particular grazing unit is a key decision affecting the profitability and viability of a grazing operation. As discussed in previous chapters, livestock intake and subsequent performance is very dependent upon forage available to the animal on a daily basis. Setting the stocking rate too low results in wasted forage and lost profit potential. Setting the stocking rate too high results in lowered intake and animal output and, very frequently, diminished profits. If a producer has been fairly successfull in a traditional grazing system, a fairly good idea of appropriate stocking rate is already available. While in the long term carrying capacity will be increased with improved grazing management, do not expect to increase stocking rate substantially in the first year of a MiG system.

SEASONAL CARRYING CAPACITY

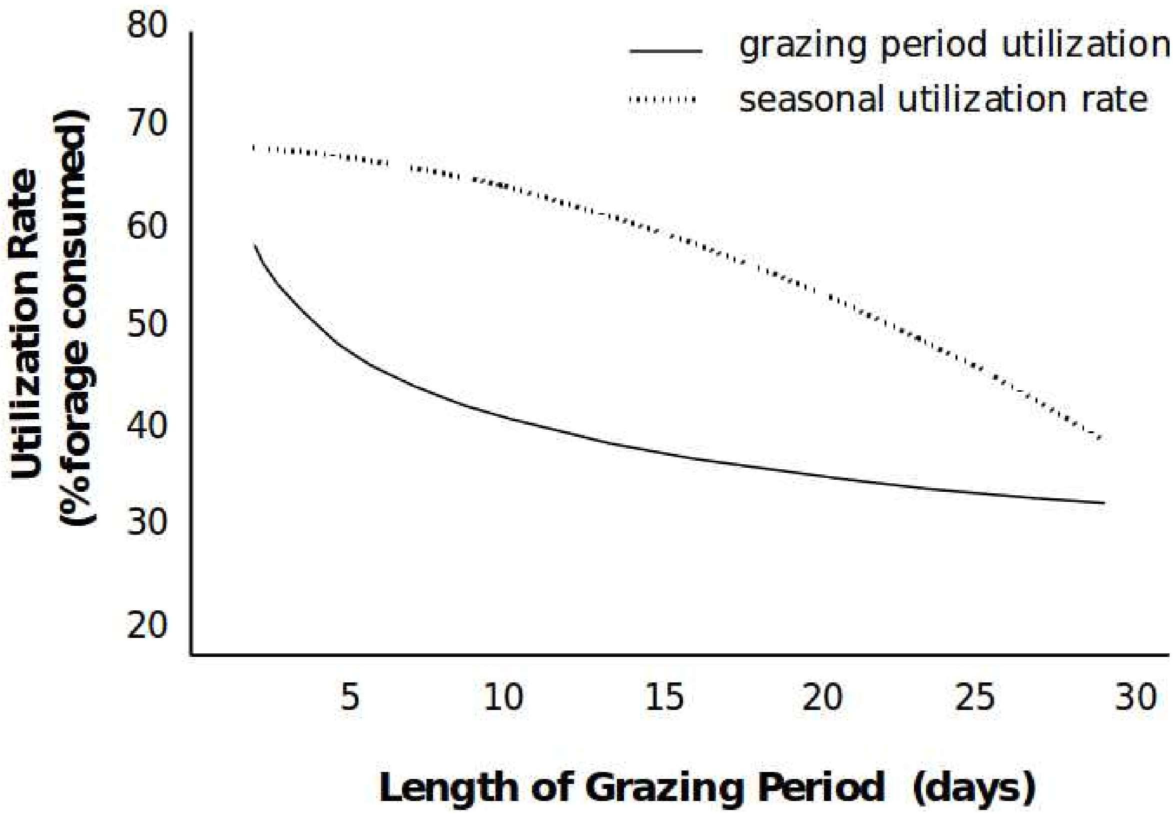
Carrying capacity is the stocking rate which is economically and environmentally sustainable for a particular grazing unit throughout the grazing season. Carrying capacity is largely determined by four factors: 1) annual forage production, 2) seasonal utilization rate, 3) average daily intake, and, 4) length of the grazing season. These terms can be expressed in the mathematical formula below:

Equation 8.1.

$$\text{Carrying Capacity} = \frac{\text{Annual Forage Production} \times \text{Seasonal Utilization Rate}}{\text{Average Daily Intake} \times \text{Length of Grazing Season}}$$

Annual forage production is the total amount of forage dry matter produced per acre on an annual basis. This would include both hay and pasture harvested from grazed acres. In the formula, this term should be expressed as lbs forage/acre.

Seasonal utilization rate is the percentage of the annual forage production which will actually be harvested by the grazing livestock. This will be very dependent upon rotation frequency and expected level of animal performance. Figure 8.1 can be used to estimate approximate seasonal utilization rate based on average grazing period length. For example on a 3-day rotation, a reasonable seasonal utilization rate would be 70 percent. Utilization rate is expressed as a unitless decimal fraction in the formula.



Average daily intake should be set at the level that will be required to yield the desired animal performance level. This may well be the most difficult part of the entire process. To accurately determine the appropriate intake value, some estimate of forage digestibility and energy is required. These values cannot be reliably determined without careful forage sampling and laboratory analysis. For this reason we tend to insert arbitrary values in this space and err on the side of overestimating intake. Average forage intake values for high, medium, and low performance of either steers or cow-calf pairs would be 3.5 percent, 3.0 percent, or 2.5 percent as a percentage of the animal's body weight.

For example a 1200 lb cow of medium milking ability would consume about 36 lb of forage dry matter on a daily basis. In the calculation, intake is expressed as lb of forage/lb of live weight.

Length of the grazing period is a function of how many paddocks are available and the required rest period. Rest period requirements are going to vary for different species and environmental conditions as discussed in earlier chapters. The choice for length of grazing period must be compatible with the utilization rate used in the calculation as indicated by Figure 8.1.

When the appropriate values have been entered into the equation and calculation made, the resulting answer is the pounds of animal live weight that each pasture acre of the grazing unit will support for the indicated grazing season.

As an example, we will assume that an average acre will produce **7600 lbs of forage annually**. If we plan to use an **average 3 day grazing period**, we find by referring to Figure 1 that the corresponding **seasonal utilization rate is approximately 68 percent**. The livestock will be steers we hope to have gain 1.5 to 2 lb/hd/day. This would be a moderate performance level, so **intake** is entered **at 3 percent of body weight** which is **.03 lb of forage/lb of live weight**. It is important to enter intake in this format, not as 3 percent so that units cancel out. We will anticipate grazing the steers from April 20 to October 1 or a total of **164 days**.

We make the following calculation:

$$\frac{7600 \text{ lb forage/acre} \times .68}{.03 \text{ lb forage/lb live weight} \times 164 \text{ days}} = 1050 \text{ lb live weight/acre}$$

The 1050 lb live weight/acre is an indication of the carrying capacity of this unit. If we purchase 525 lb steers, can we stock the unit at 2 steers (1050 lb live weight/acre ÷ 525 lb/steer) to the acre? Only on the first day of the season! Why? Because the animals are, hopefully, gaining weight every day and quite likely the average forage availability in August is lower than that in May. If expected average daily gain is 1¾ lb/hd/day, the the average weight of steers at mid-season will be 668 lb (525 lb + (82days X 1¾ lb/day)). Initial **stocking rate** could be set at **1.6 steers/acre (1050 lb live weight/acre ÷ 668 lb live weight/steer**). Remember this is a guideline to help make initial stocking decisions, not a magical recipe for universal financial success.

GRAZING PERIOD STOCK DENSITY

After making basic farm stocking decisions, the time comes for every beginning grazier to make the actual decision of where to place a break fence or how many animals to place in a particular paddock. That decision is based on the same principles used in the carrying capacity equation discussed above but modified to represent single grazing period conditions rather than seasonal values.

The carrying capacity equation becomes the stock density equation with the following modifications:

Equation 8.2.

$$\text{Stock Density} = \frac{\textbf{Available}\text{ Forage} \times \textbf{Grazing Period}\text{ Utilization Rate}}{\text{Average Daily Intake} \times \text{Length of Grazing }\textbf{Period}}$$

Available forage is the quantity of forage dry matter that is actually allotted to the animals for a grazing period. Accurately measuring forage availability is time consuming and expensive so we tend to rely on estimations of yield. The simplest method is to look at a pasture and make an educated guess as to what the forage availability is likely to be. With practice, a good grazier can consistently estimate within 20 percent± the actual yield. A second method relates height and condition of the pasture to dry matter yield. Height X dry matter yield relationships for several types of pasture are given in Table 8.1.

The stand condition is determined based on visual estimate of green plant ground cover after the paddock has been grazed to a 2-4 in residual. An **excellent** stand has at least **90 percent** of the ground covered by green plant material or less than 10 percent exposed soil. The **good** condition has **75 - 80 percent** ground cover or 10 - 25 percent bare ground. **Fair** condition has **less than 75 percent** ground cover or greater than 25 percent bare ground exposed. In all cases, moderate soil fertility is assumed.

The following example illustrates how to determine where to place a temporary fence to create a paddock to feed a herd of **100 steers** weighing **600 lb/hd** for **3 days** with a rate of gain objective of **2.25 lb/hd/day**. The pasture is **orchardgrass-red clover 8-10 inch tall** and the area where the steers have just finished grazing has about **20 percent bare ground**. The pasture is **40 acres** that is **660 ft wide**. To use the stock density equation we must first determine the appropriate values.

Forage availability can be estimated from Table 8.1 using the average sward height of 9 inches and the stand condition as good. The corresponding value for an orchardgrass-legume pasture is approximately 250 lb/acre-inch so the available forage **2250 lb/acre** (9 inch X 250 lb/acre-inch).

Table 8.1 Estimated dry matter yield in pounds per acre-inch for several pasture types and stand conditions.

Pasture Species	Stand Condition Fair	Good	Excellent
	------------- (lb/acre/inch)		----------------
Tall Fescue + N	250-350	350-450	450-550
Tall Fescue + Legumes	200-300	300-400	400-500

Equation 8.1 can be used to estimate the appropriate **utilization rate** for a **3 day grazing period**. As an average daily gain of **2.25 lb/hd/day** is a high performance objective, utilization can not be excessive or else intake will be limited. To maintain an intake rate of **3.5 percent of body weight**, a **50 percent utilization rate** appears to be appropriate to use in the calculation. Assuming the 3 day grazing period, we can make the following calculation:

$$\frac{\textbf{2250 lb forage/acre X .5 utilization rate}}{\textbf{.035 lb forage/lb live weight X 3 days}} = \textbf{10,455 lb live weight/acre}$$

The steers weigh **600 lb/head** and each acre will support **10,455 lb live weight**, so the pasture can be stocked at the rate of **17 steers/acre/3 day period** (10,455 lb live weight/acre ÷ 600 lb live weight/steer). The herd of **100 steers** will require **5.8 acres/paddock (100 steers ÷ 17 steers/acre)**.

For ease of figuring, assume 6 acres per feed strip. It is better to give a little more and waste a little feed than to allow too little and limit intake. To determine where to place the fence, calculate the total square footage in the 6 acres **(6 acres X 43,560 ft^2 /acre = 261,360 ft^2**) and divide by the known width **(261,360 ft^{2++}660 ft = 396 ft)**. Placing the temporary fence at approximately 400 ft will give adequate forage for the 100 steers for the 3 day grazing period.

It is very important that values used for the parameters in the equation are realistic in how they relate to one another. All of the parameters are interelated and inserting an inappropriate value for any one parameter will result in erroneous conclusions. For example if available forage is below 1500 lb/acre, an intake of 3.5 percent would be impossible to achieve. For this reason, the equation cannot be used as most mathematical formulas where if all but one value is known the remaining value can be calculated. A calculation can be made, but the result may be biologically meaningless.