



# HOW MANY ANIMALS CAN I GRAZE ON MY PASTURE?

## DETERMINING CARRYING CAPACITY ON SMALL LAND TRACTS

### Introduction

Many landowners are interested in purchasing horses and other livestock to graze their property. To ensure that the animals have sufficient forage to remain healthy and to ensure that grazing does not permanently damage soil and vegetation resources, animal numbers and/or grazing time must be controlled. If either too many animals are allowed to graze or animals are allowed to graze too long, forage will be adversely affected. Repeated removal of forage by grazing animals will weaken plants and allow less palatable plants to replace them. Eventually all forage plants will be eliminated from a pasture if heavy grazing is left unchecked. In the extreme, uncontrolled grazing can change a pasture with grasses and other forage into a dirt lot with a few weeds.

Without vegetation to stabilize the soil, wind and water erosion will remove the soil. Wind erodes unprotected soil resulting in dust and poor air quality. Water also erodes unprotected soil and increases sediment load in watersheds and decreases water quality. Poor grazing management can adversely affect neighboring landowners. The objective of this paper is to provide owners of small land tracts some approaches to determining initial carrying capacity and refining the initial carrying capacity estimate.

### What is Carrying Capacity?

Carrying capacity is the maximum stocking rate possible without inducing damage to vegetation or related resources (Bryant et al. 1978). It may vary from year to year on the same area due to fluctuating forage production. Carrying capacity uses the term stocking rate which is simply the number of animals on a given area at any one time.

### Stocking rate

In order to document the length of the grazing period while describing stocking rate, land managers have developed the term Animal Unit Month or AUM.

An AUM is the amount of forage required to support an 1000 lb. cow for one month. For our purposes, we will assume that this is equivalent to 900 lbs. of forage (30 lbs. of forage per head per day). The grazing period of a 1000 lb. cow is another way to view an AUM. For example, if 5 cows grazed a pasture for 5 months, the stocking rate would be 25 AUMs. If 10 cows grazed a pasture for 2.5 months, the stocking rate would also be 25 AUMs. In both cases, we would assume the cows would harvest approximately 22,000 lbs. of forage (25 AUMs x 900 lbs. of forage per AUM).

An AUM is simply a standard to which grazing of various kinds of livestock can be compared. Since horses eat more than cattle, a horse would eat more than 1 AUM of forage during a month. However, a sheep or a goat would eat less than 1 AUM of forage. An AUM can be thought of as a box of forage that weighs 900 lbs. or the tenure (the length of the grazing period) of the standard animal, a 1000 lb. cow.

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Carrying capacity and stocking rate (expressed in AUMs) both refer to the tenure of the animals allowed to graze in a pasture and the amount of forage that we expect these animals to harvest. Stocking rate does not reflect the effects of the grazing on the vegetation and soil resources. Carrying capacity is the maximum sustainable stocking rate which does not result in a deterioration of soil and vegetation integrity.

## Calculating initial carrying capacity

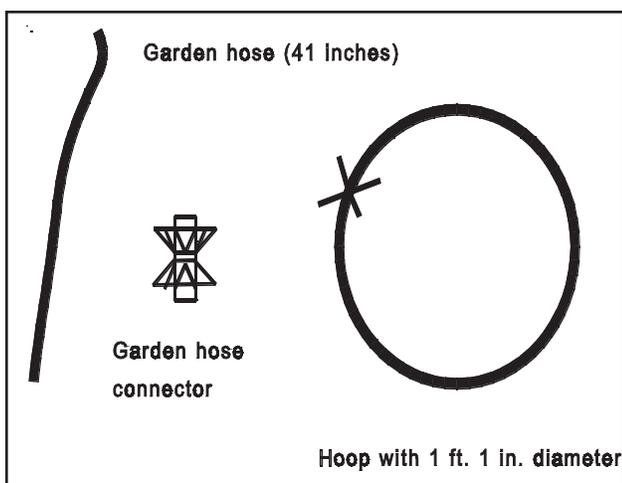
The first step is to determine the forage production of your pasture, or the number of AUMs in the pasture. The second step is to determine the number of animals allowed to graze and/or the grazing time. How are these AUMs going to be used? Forage production is usually referred to in lbs. of forage per acre or AUMs per acre.

## Measuring forage production

You can determine the forage production on your property using some simple equipment and patience. You can clip forage on your pasture if the area hasn't been grazed and if most of the forage growth has already occurred. If the area has been grazed or if forage growth has not occurred, the results from clipping will not reflect total forage production. September or October, after the monsoon rains, is the ideal time to clip if the forage is primarily warm season grasses. The required equipment consists of a pair of grass clippers, an old piece of garden hose (41 inches long), a garden hose connector and paper bags.

Connect both ends of the garden hose with a connector that will allow the ends of the garden hose to be within 0.25 to 0.5 inches from each other. The resulting hoop should enclose approximately 0.96 sq. ft. (approximately 1 ft 1 inch diameter).

Randomly place the hoop at 10 locations in small pastures (1-2 acres)<sup>1</sup>. You can do this by throwing the hoop behind your head at several locations in the pasture. Throwing the



hoop behind your head helps minimize any biases resulting from selective placement of the hoop. Clip all the palatable forage in the hoop and place it in a paper bag. Do not place unpalatable vegetation such as cactus or snakeweed in the paper sack. (Avoid clipping near cactus plants to prevent injury!). Clip the vegetation to ground level. The purpose is to weigh all the palatable forage that is rooted within the hoop. Repeat the clipping process at all 10 randomly selected spots. Put the forage from all 10 hoop placements into the same bag. Using a nail, put some holes in the sack to allow some air flow through the sack. Place the sack in a hot dry location such as an attic, or garage for 10 or more days and allow the forage to completely dry.

After the forage is dry, weigh the bag and forage in grams and record the weight. Empty the forage and weigh the bag to get the net forage weight in grams. Postage scales may be adequate for weighing the forage, but the weights must be converted from ounces to grams (1 ounce = 28.3 g). Forage production in lbs./acre is determined by multiplying the net forage weight (from the 10 hoops) by 10. If the forage from 10 hoop placements (10 x .96 sq. ft. = 9.6 sq. ft.) was 50 grams, total forage production would be 500 lbs. / acre.

## Available forage and proper use factors

To avoid injuring forage plants, only a portion of plants should be harvested by grazing. The rule-of-thumb take half-leave half has been a standard in the range management profession for years. Therefore, only 50% of the forage production measured on your pasture should be harvested. If total measure forage production was 500 lbs./acre, only 250 lbs./acre is available and should be grazed. This 50% proper use factor is only a guideline and may need to be changed under different grazing regimes.

**The total number of AUMs that can be grazed is calculated as follows:**

$$\text{Total forage production (lb/acre)} \times \text{proper use factor (\%)} = \text{available forage (lb/acre)}$$

$$\text{Available forage in the pasture (lb/acre)} = \text{available forage (lbs/acre)} \times \text{pasture size (acres)}$$

$$\text{AUMs in pasture} = \frac{\text{available forage in pasture (lb/acre)}}{900 \text{ lbs. forage/AUM}}$$

<sup>1</sup> If the pasture is larger than 1-2 acres, additional clipping and hoop placement is needed. For example if the pasture is 4 acres divide the pasture in half. On one half, clip 10 randomly placed hoops and place the forage in a bag. On the other half of the pasture, clip another 10 randomly placed hoops and place the forage in a second bag. In all cases, a total of 10 hoops should be clipped and the forage placed in each bag.

**Example:**

<b>Given</b>
<ul style="list-style-type: none"> <li>• Pasture size = 2 acres</li> <li>• Dry weight of forage from clipping 10 (.96 sq. ft) hoops = 45 grams</li> <li>• Proper use factor = 50%</li> <li>• AUM = 900 lbs. of available forage</li> </ul>
<b>Calculations</b>
<p>Total forage production = 45 g x 10 (total of 9.6 sq. ft) = 450 lbs/acre</p> <p>Available forage = 450 lbs/acre X .50 = 225 lbs/acre</p> <p>Available forage in pasture = 225 lbs/acre x 2 acres = 450 lbs.</p> <p>AUMs in pasture = 450 lbs. / 900 lbs/acre = 0.5 AUMs</p> <p>Thus, a 1000 lb cow could graze this pasture for 15 days.</p>

**General Guidelines for Forage Production.** Clipping vegetation is the best way to get an initial carrying capacity. However, we can provide some general guidelines to use for estimating forage production. The following table gives some estimates of forage production based on published data. The capacities are given in acres/AUM. This is a common value to use when comparing the forage production in different areas. It is simply the acres needed to produce an AUM or 900 lbs. of forage or the acres necessary to sustain a 1000 lb. cow for a month.

From this table we know that we can expect that most

Table 1. Very General Guidelines of Forage Production

<b>Location</b>	<b>Vegetation type</b>	<b>Forage production</b>	<b>Source</b>
Gila County - upper elevation	native rangeland	4-6 acres/AUM	
Pima County - low elevation	native rangeland	10 -13 acres/AUM	Martin and Severson (1988)
Pima County - mid elevation	native rangeland	5-8 acres/AUM	
Pima County - higher elevation	native rangeland	4 acres/ AUM	
Pima County	Lehmann lovegrass	1 acre/AUM	Ruyle et al. (1988)

rangelands in Gila County will produce around 4 acres/AUM in higher more productive areas and in lower elevations 10 acres may be required for an AUM. In very productive areas, with introduced grasses, only 1 acre may be required to produce an AUM of forage. With irrigation or in subirrigated areas, forage production may be 0.25 to 1 acre per AUM. **However these are only general guidelines, and measurements such as those described above are needed to accurately estimate initial carrying capacity.**

Using this information, we can get some rough ideas of forage production in Gila County. For example, if you have a native rangeland pasture in Gila County, you should expect that a cow will require 4 acres to graze for one month (4 acres/AUM). These guidelines can also be used to check your clipping estimates. If results from your clipping data are dramatically different from the guidelines (eg., 0.5 acre/AUM instead of 4 acre/AUM), you should conduct the clipping study again and compare the values from the two studies, or contact your Cooperative Extension Agent.

### How many animals for how long?

If you know how many AUMs of forage are available, you can either determine how many animals you can graze in a given time period or determine how long you can graze a given number of animals. The following discussion will explain how to make both of these calculations.

Since different animals eat different amounts of feed, stocking rate calculations must use factors to equalize among different kinds and ages of animals. An AUM is based on a 1000 lb. cow. This 1000 lb. cow is termed an Animal Unit Equivalent (AUE), so a 1300 lb. cow would be equal to 1.3 AUE. The following values adapted from Holechek et al. (1989) are used to make the conversions to the 1000 lb. cow AUE standard.

- Cow (1000 lb.) = 1.0 AUE
- Horse = 1.3 AUE
- yearling cattle = 0.7 AUE
- sheep = 0.2 AUE
- goat = 0.2 AUE

To estimate how many animals you can graze for a given period use this equation:

$$\text{No. of animals} = \text{AUMs in pasture} / (\text{grazing period in months} \times \text{AUE})$$

**Example:** How many sheep are needed to properly graze pasture with a carrying capacity of 1.5 AUMs in 2 weeks?

<b>Given</b>
1.5 AUMs in pasture (eg., 15 acres at 10 acres/AUM) Grazing period = 2 weeks or 0.5 months species = sheep (being 0.2 AUE)
<b>Calculations</b>
No of animals = $1.5 / (0.5 \times .2) = 15$ sheep

To estimate how long you can graze a given number of animals use this equation:

$$\text{Grazing period in months} = \text{AUMS} / (\text{no. of animals} \times \text{AUE})$$

**Example:** How long can 1 horse graze in a pasture with a capacity rate of 0.5 AUMs?

<b>Given</b>
0.5 AUMS in pasture (2 acres at 4 acres/AUM) 1 horse (being 1.3 AUE)
<b>Calculations</b>
Grazing period = $0.5 / (1 \times 1.3) = 0.38$ months or 11.5 days

## Refining your estimate of carrying capacity

Estimates of carrying capacity based on clipping measurements and especially general guidelines should be refined through monitoring. This can be a simple process of recording the number of animals in a pasture and the length of the grazing period when the forage has been grazed to a proper level. The proper level is reached when the forage has been harvested to a utilization level equal to a proper use factor such as 50%, take half, leave half.

In other words, remove the livestock when forage utilization equals 50%. The tenure of animals (in AUMs) when the utilization equals 50% is the desired stocking level. For example, forage utilization increased from 0 to 50% after 1 horse grazed for 15 days. The desired stocking level is the actual tenure of the horse in AUMs since grazing stopped at 50% utilization. The actual grazing tenure can be calculated by following equation.

$$\text{Actual Use (tenure in AUMs)} = \text{number of animals} \times \text{AUE} \times \text{grazing period in months}$$

Example above:

$$\text{Actual Use (tenure in AUMs)} = 1 \times 1.3 \times 0.5 = 0.65 \text{ AUMs}$$

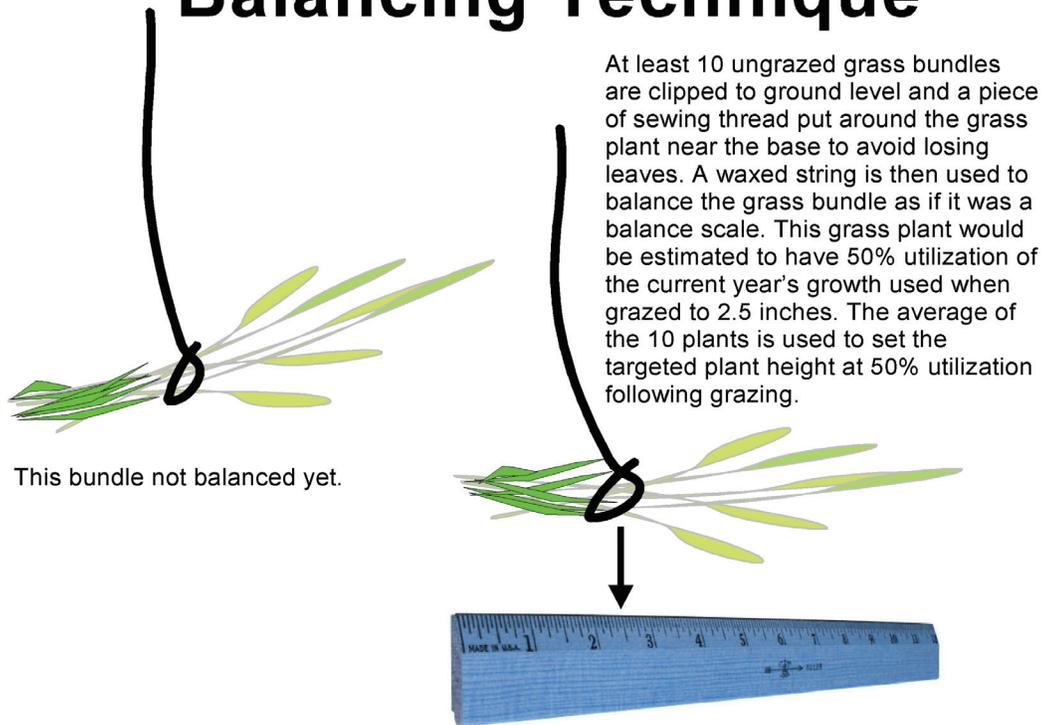
Note: 15 days equals 0.5 months

To monitor and eventually refine carrying capacity estimates requires determinations of forage utilization. A simple procedure to estimate utilization is described in the figure below. Find 10 plants that have not been grazed and clip them to ground level. You use a balance procedure with the clipped grass plants to estimate 50% use of the forage grown for that year. Record the average plant height from the 10 plants at which 50% utilization is noted and then manage grazing to not exceed that level of utilization (graze plants no shorter than the 50% utilization guideline). Each year's rainfall patterns will differ so this procedure will need to be repeated during each growing season. It should be noted that the 50% utilization guideline is based upon measurements obtained following annual forage production at the end of the growing season. Forage utilization estimated while the plants are still growing will change and is referred to as *relative* forage utilization.

This process should be repeated for several years, and the desired stocking levels recorded. The average of several years of desired stocking rate calculations often result in good estimates of carrying capacity.

As a general rule, forage utilization will be close to 50% when the average stubble height is between 2.5-4 inches for bunch grasses and 1.5-2 inches for mat grasses. If forage in the pasture is primarily bunch grasses such as love grasses, squirrel tail, and sideoats grama, removal of livestock from the pasture should be considered when average stubble height is between 2.5 - 4 inches. If the forage is primarily mat type grasses such as Bermuda grass, blue grama or curly mesquite, removal of livestock should be considered when the average stubble height is between 1.5-2 inches. Note these stubble height guidelines do not correspond to actual forage utilization values and may be above or below 50% utilization. Use the technique described in Figure 2 to estimate forage utilization. However, if livestock are removed from a pasture before average stubble heights

# Balancing Technique



in a pasture exceed these guidelines, very heavy (ie., more than 75%) and potentially damaging utilization levels will be avoided.

## Implications

Most small land tracts in Arizona, less than 10 acres, do not have the carrying capacity to support even one horse or cow for a year. Unless the site is irrigated or subirrigated, forage production will rarely exceed 1 acre/AUM, and most rangeland pastures will require at least 4 acres to provide an AUM of forage. Thus, to support a horse for a year would require more than 60 acres of rangeland pasture.

Livestock should be kept in a corral or a dry lot and not allowed to graze in the pasture after forage utilization has reached the proper use factor (usually 50%). Even if horses or other livestock are supplemented with hay, they will continue to graze if given an opportunity. Livestock will graze forage to utilization levels approaching 80 to 100% if they are kept in a small pasture and fed hay. At such heavy utilization levels, forage plants will weaken and eventually die. Only weeds, unpalatable plants and/or bare ground will remain.

After livestock have grazed to a level equal to the proper carrying capacity, keep the livestock out of the pasture until the following year or until it has regrown<sup>2</sup>. Move the animals to another pasture or keep them in a corral or pen. In pastures that have been grazed to a level equal to the

carrying capacity, caution should be given when allowing animals to exercise in them. Do not allow the animals to stay in the pasture long. Remove the animals if they begin to graze continuously.

If you have a small pasture and you want to release animals into the pasture regularly, you may want to consider releasing the animal(s) only a short period each day (10 to 20 minutes per day). Do not rely on the pasture to supply any of the forage required by the animals. By turning them out only a short period, the animals should spend little time grazing. With light utilization levels, plants will have more tolerance of the trampling associated with animal exercise. Monitor utilization levels, and reduce the amount of time that animals are in the pasture if utilization approaches 50%.

<sup>2</sup> If moisture and climatic conditions are adequate, forages will regrow after grazing. Forages should be allowed at least 40 days to regrow before turning livestock back in the pasture. After livestock are returned to the pasture, utilization and stubble height of the regrowth should be monitored closely. Utilization of regrowth should be less than or equal to 50% so that stubble height during the second grazing period remains equal to or higher than the initial stubble height.

## Sources

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