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Animal Unit Month (AUM) Concepts and Applications for Grazing Rangelands

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What is an AUM?

AUM means Animal Unit Month and is frequently used to determine sustainable stocking rates for grazing pasture and rangeland in the west.

Federal land management agencies also use AUMs to manage grazing allotments. AUMs can also be useful for managing private lands grazing because they link animal demand with forage supply. Understanding how to estimate and calculate AUMs helps livestock producers manage for sustainable grazing and maintain their federal grazing permits.

An AUM is the amount of air-dry forage a 1,000-pound cow and her un-weaned calf will

consume (the 'Animal Unit') in one month. The AUM was developed in the mid-twentieth century when average cow weights were closer to 1,000 pounds than today's weights. Sources define an AUM as 750 pounds of forage needed for an animal unit for a month. These figures are based on the assumption a cow will consume 2.5 percent of her body weight equivalent in air dry forage daily.

The proportion consumed by a cow changes as forage quality changes. AUMs have been commonly standardized at 750 pounds of forage because a 1,000-pound cow consuming 2.5 percent of her body weight equivalent per day for a month is equal to about 750 pounds. For this bulletin, and with this history of AUMs in mind, we will define an AUM as equivalent to 750 pounds of dry forage.

When working with range management professionals, livestock producers should be careful to make sure all parties agree on the definition of an AUM. This will be an important consideration when working with land management agency range conservationists and private land grazing lease situations.

Animal Unit Equivalent (AUE)

To plan grazing for cattle that weigh more or less than 1,000 pounds and for other species/classes of animals, a method is needed for converting

Table 1. Classes of livestock and wildlife and their animal unit equivalents (AUEs)

Class of Animal	Animal Unit Equivalent
Cow, 1000 lb, dry	0.92
Cow 1000 lb, with calf	1.00
Bull, mature	1.35
Cattle, 1 year old	0.60
Cattle, 2 years old	0.80
Horse, mature	1.25
Sheep, mature	0.20
Lamb, 1 year old	0.15
Goat, mature	0.15
Kid, 1 year old	0.10
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

Table 2. Examples of different cow weights and their corresponding animal unit equivalents (AUEs)

Class of Animal	Animal Unit Equivalent
Cow 1000 lbs, with calf	1.0
Cow, 1200 lbs, with calf	1.2
Cow, 1400 lbs, with calf	1.4
Cow, 1600 lbs, with calf	1.6

from the forage requirements of a 1,000-pound cow/calf pair to another class of grazing animal. Animal Unit Equivalents (AUE) are a conversion of an AU (1,000 lb cow) to smaller or larger animals such as bulls or sheep. Table 1 offers standard values for these animal unit equivalent of various species/classes. See also Figure 1, page 3.

Each class of animal in the left hand column has an AUE value in the right hand column. Table 2 lists different cow weights with corresponding AUEs. This AUE is an estimate of the relative percentage to the base cow/calf Animal Unit relative to forage consumption. Readers will note a mature sheep has an AUE of 0.20. This means the sheep will consume 20 percent of what a 1,000-pound cow would. Or, 20 percent of an AUM, which is 150 pounds (750×0.20), of air dry forage monthly. This also means five sheep are the equivalent of a 1,000-pound cow or 1 AU as calculated by $1 \div 0.2 = 5$.

Requirements for other species/classes are figured in a similar manner. Multiply the AUE by 750 to produce an estimate, in pounds, for the monthly forage requirement.

AUEs should also be adjusted relative to cow size. A 1,400-pound cow will consume more forage than a 1,000-pound cow and can be considered a 1.4 AUE. Although consumption is known to not be exactly linear to body size, we will use a 1:1 ratio as this generally works for basic calculations and is pretty close (in other words, 1,000-pound cow = 1.0 AUE; 1,100-pound cow = 1.1 AUE; 1,200-pound cow = 1.2 AUE, etc.).

Utilization Rate

There are other terms and concepts useful for planning grazing. Utilization rate is the amount of the overall forage produced that will be harvested by the grazing animals. We don't want to use 100 percent of the forage in most grazing systems. By leaving some forage un-grazed, grazing habitat is provided for other users, such as wildlife, and managed for the health and sustainability of the forage species.

A general rule of thumb for rangeland is “take half – leave half” or a 50 percent utilization rate. In some cases such as irrigated pastures or dormant season grazing, a higher utilization rate can be used without damaging forage species, which is a function of the species of forage and the moisture environment. Be specific about what grazing is counted toward meeting the set utilization rate when setting utilization rates. A 50-percent utilization might mean all grazers (livestock, wildlife, wild horses, insects) use must not exceed 50 percent. This may mean substantially less than 50 percent of the total forage is for livestock alone. Generally, the utilization rate has to be adjusted relative to the Harvest Use Efficiency or HUE (for information see the USDA NRCS Technical Note Range No. 73 “Harvest Efficiency in Prescribed Grazing” at the end of the bulletin).

HUEs are not always used in lease agreements and not usually used on public lands, but may be found on private lands leases. HUE adjusts for forage lost to wildlife herbivory, trampling, defecation, and being bitten, but not eaten. This adjustment is

typically 25 percent. The “take half-leave half” or 50 percent utilization rate actually only accounts for 25 percent of the total forage available going to livestock grazing. If there is 1,000 pounds of forage per acre, based on this Harvest Use Efficiency, only 250 pounds of forage per acre would be allocated to livestock grazing, 250 pounds of forage to wildlife or waste/trampling, and 500 pounds of forage for photosynthetic growth and restoration of root reserves for future growth. Utilization rates on federal grazing permits may be based on how much a key species is grazed. Animals will be expected to be moved once a set amount of utilization is achieved on one or two key species.

Stocking Rate

Stocking rate refers to the relative grazing pressure on a given parcel of land over a given amount of time. Stocking rates are expressed in different units or configurations of units, but they always must have three components: (1) some form of an animal unit, (2) a unit of land area, and (3) a unit of time. Examples of different ways stocking rates are expressed can include the following: number of

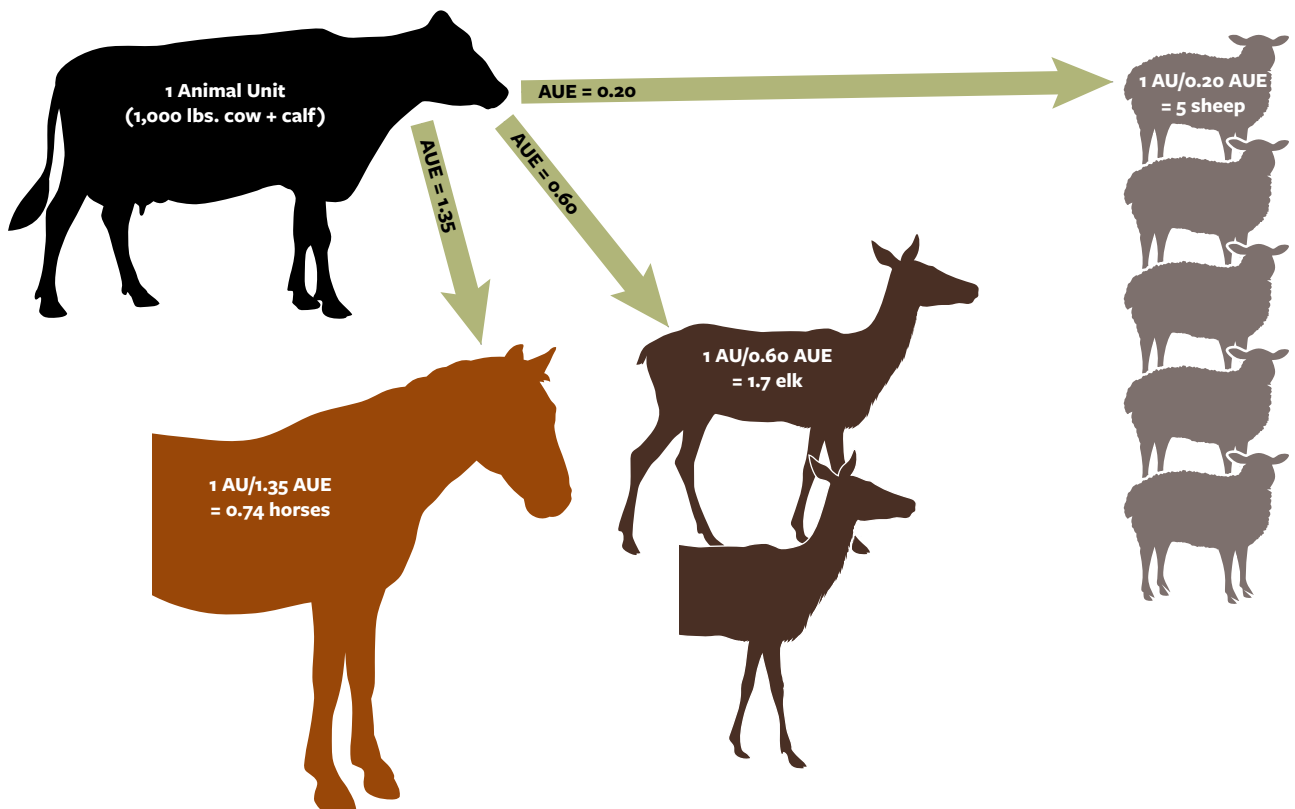


Figure 1. Conversion of AUE (animal unit equivalents) for horses, elk, and sheep relative to the definition of an AU (animal unit), which is a 1,000-pound cow with a calf.

acres per cow for a year, number of cows per acre for a year, number of cows per section (640 acres) per year, etc.

The different expressions are often regional in nature. Thinking in number of cows per acre is common in wetter areas of the country but in the west, stocking rates may be expressed in the number of cows per section or number of acres needed per cow. Because cows vary in size and nutrient requirements, more accurate is to adjust the class or species of animal (such as cows that might weigh 1,400 pounds, yearlings that weigh 600 pounds, or ewes) to a standard animal unit (AU) as described above. The common expression is AUMs per acre.

If a 1,500-acre pasture can handle 50 cows that weigh 1,000 pounds each for 6 months, then the stocking rate would be 300 AUMs for the 1,500 acres or 0.2 AUMs per acre ($50 \text{ cows} \times 1.0 \text{ AUE} \times 6 \text{ months} = 300 \text{ AUMs}$; $300 \text{ AUMs} \div 1,500 \text{ acres} = 0.2 \text{ AUMs per acre}$). If there are 1,400 pound cows with a 1.4 AUE, then only about 35 of these larger cows can be accommodated for the same amount of time ($300 \text{ AUMs} \div 6 \text{ months} = 50 \text{ AU}$; $50 \text{ AUs} \div 1.4 \text{ AUEs} = 35 \text{ cows}$).

Stocking Density

Stocking density is the number of livestock animals in a specific area at a single point in time. The difference between stocking rate and stocking density is stocking density does not express a unit of time. Stocking density can be expressed in

Calculating forage production using stocking rate

$$50 \text{ (cows)} \times 1.3 \text{ AUE} = 65 \text{ AU}$$

$$65 \text{ AU} \times 750 \text{ lbs}^a = 48,750 \text{ lbs/month}$$

$$48,750 \text{ lbs} \times 2 \text{ months} = 97,500 \text{ lbs/season}$$

$$97,500 \text{ lbs} \times 1.66^b \text{ (1/utilization rate)} = 161,850 \text{ lbs of forage}$$

^a Forage eaten by an AU in one month.

^b 1/utilization rate to account for the other 40% of the forage not consumed.

the number of animals per area. If there are 100 cows on a 20-acre pasture, the stocking density is five cows per acre ($100 \text{ cows} \div 20 \text{ acres} = 5 \text{ cows per acre}$).

Carrying Capacity

The carrying capacity for rangelands is based on the sustainability of livestock grazing through time. Carrying capacity is based on the amount of forage a unit of land can grow and the maximum utilization rate and stocking rate for livestock that can be sustained over time without any degradation of the soil and plant resources. Carrying capacity also considers the idea of some acceptable level of livestock performance. Typically, the optimum balance between livestock performance and soil and plant sustainability occurs at a compatible intermediate stocking rate. Note that carrying capacity or grazing capacity varies from year-to-year based upon timing and the amount of precipitation and how favorable overall conditions were for growing forage.

The carrying capacity in drought years can be reduced by as much as 50 percent simply because drought conditions reduced forage yields. On the other hand, during above average precipitation years, carrying capacity may increase substantially due to ideal grass growing conditions. The point is grazing managers should recognize the capacity of their rangeland can vary year-to-year, and grazing capacity should be evaluated annually.

Estimating Forage Production

Range managers frequently need to have an estimate of how much forage is in a given pasture. Clipping, drying, and then weighing forage from plots within a pasture is one method often used and suggested for forage production estimates. This method works best in pastures uniform in production. Irrigated hay meadows and pastures lend themselves well to this method, but upland range sites are not as suited.

Records of how much hay was harvested off a hay meadow can provide a good estimate of forage production. Forage production tends to be variable across large dryland range pastures because of changes in elevation, soils, aspect, and water

availability. Clipping and weighing enough plots to get a statistically valid sample on range pastures may not be practical for estimating forage production.

Using AUMs to Calculate Forage Production

The concept of AUMs is very flexible because it relates to both forage supply and animal demand (Figure 2). AUMs can be a useful alternative for determining animal units or estimating forage production. In the instance a producer is assigned a set number of AUMs relative to some utilization rate, a calculation can be made to predict approximately the amount of forage produced. For example, assume there is a 1,500-acre pasture with a set allocation of 300 AUMs at an assumed standard of “take half-leave half” adjusted for the 25 percent Harvest Use Efficiency. Recall from the AUE section above an AUM is approximately 750 pounds of air dry forage. So, $300 \text{ AUMs} \times 750 \text{ pounds of forage} = 225,000 \text{ pounds of forage}$ allocated to livestock. If this accounts for only 25 percent of the total forage grown, multiply by a factor of 4 to yield a total of 900,000 pounds of forage on the 1,500-acre pasture or 600 pounds of forage per acre.

Calculating forage production can be done from another perspective where we may not have an assigned or allotted number of AUMs. We can still make the estimate by using our grazing records. You'll need the number of head, their average weight, how long they grazed the pasture, and to what utilization rate. An example would be 50 head of 1,300 pound cows for 2 months and they grazed 60 percent of the forage. The equation looks like this with those figures: $50 \text{ head} \times (750 \text{ pounds of forage} \times 1.3 \text{ AUE}) \times 2 \text{ months} = 97,500 \text{ pounds of harvested feed}$. But they are only allowed to graze 60 percent of the forage in the pasture, so the total production of the pasture is $97,500 \text{ pounds} \times 1.66 = 162,500 \text{ pounds}$ (1.66 indicating grazing 60 percent of the forage). Calculate the total forage production and not just the amount of harvested forage. Knowing the total forage production enables planning future stocking rates at different levels of utilization. For instance, under a winter dormant season grazing scenario, more of the forage could be safely used than during the growing season.

The concept of AUMs can also help if wanting to make changes to grazing plans such as the class of animals or length of grazing season. For example, assume a rancher has 1,000 acres that produce 1,500 pounds of forage per acre. Let's allow a 50 percent utilization rate. How many 1,200-pound cows could be run for three months?

First, calculate the forage supply available to the cattle. $1,000 \text{ acres} \times 1,500 \text{ pounds} \times 0.50 \text{ utilization rate} = 750,000 \text{ pounds of forage}$. An AUM is 750 pounds so this pasture has $750,000 \text{ lbs of forage} \div 750 \text{ lbs of forage per AUM} = 1,000$ available AUMs. This pasture would have enough forage for 1,000 head of 1,000 pound cows for one month.

What if we want to know how many 1,200 pound cows we can graze for three months? Change the demand side of the equation a little using an animal unit equivalent from the chart above (1.2 in this case since our cows' average weight is 1,200 pounds). Forage supply will remain the same. So the equation becomes $[750,000 \text{ lbs} \div (750 \text{ lbs of forage} \times 1.2 \text{ AUE})] = 833$ head of 1,200 pound cows for one month.

Now we will account for the 1,200 pound cows we need to graze for three months. Then just divide the total number of cows by three months. $833 \text{ head} \div 3 \text{ months} = 277$ head of 1,200 pound cows for three months.

Consider another grazing decisions situation. How many head of 700 pound yearlings could be grazed for four months in the same pasture at the same level of utilization as above? The forage supply will stay the same but the demand and length of grazing season will change. This time we'll use an animal unit equivalent factor of 0.7 from the chart since the yearlings weigh 700 pounds on average. $[750,000 \div (750 \times 0.7)] \div 4 \text{ months} = 357$ head of 700 pound yearlings for four months.

We'll change the forage supply as well as the class of animal in our final example. Consider that now the sub-irrigated hay meadow being grazed is comprised of an improved forage species instead of native upland range. We might change the

utilization rate from 50 percent to 70 percent. This means the forage available for livestock grazing will be 1,050,000 pounds of forage. Assume we are going to winter 2,200 pound bulls for four months. $[1,050,000 \div (750 \times 2.2)] \div 4 \text{ months} = 159 \text{ head of } 2,200 \text{ pound bulls for } 4 \text{ months.}$

We have presented four examples in Figure 2, where you can use known information about your forage production or livestock to predict forage supply or animal demand. These four things are: (1) pounds of forage per acre, (2) AUMs per acre or acres per AUM, (3) animal weight, or (4) number of animals. Remember, AUMs are flexible and can lead to either side of the equation: forage supply or animal demand.

What if the Math is Difficult?

We've created an online AUM calculator to do the math for you. Producers will need to enter number of head, average weight, number of days

grazing, acres in pasture, and utilization rate. Utilization rates should be entered as a decimal (for example, 0.5 for 50 percent). The calculator will produce a total forage production estimate for that time period. Forage production will vary from year-to-year.

This estimate can then be used in one of the other two calculators to create a new grazing plan. One of the calculators is designed for producers who have a set time to graze a pasture. The other calculator is for producers who have a grazing situation where there is no time limit. It will calculate how long a pasture can be grazed for a specific weight class of livestock and desired utilization rate.

The calculators can be found here:

<http://uwyoextension.org/ranchtools/stocking-tool/>

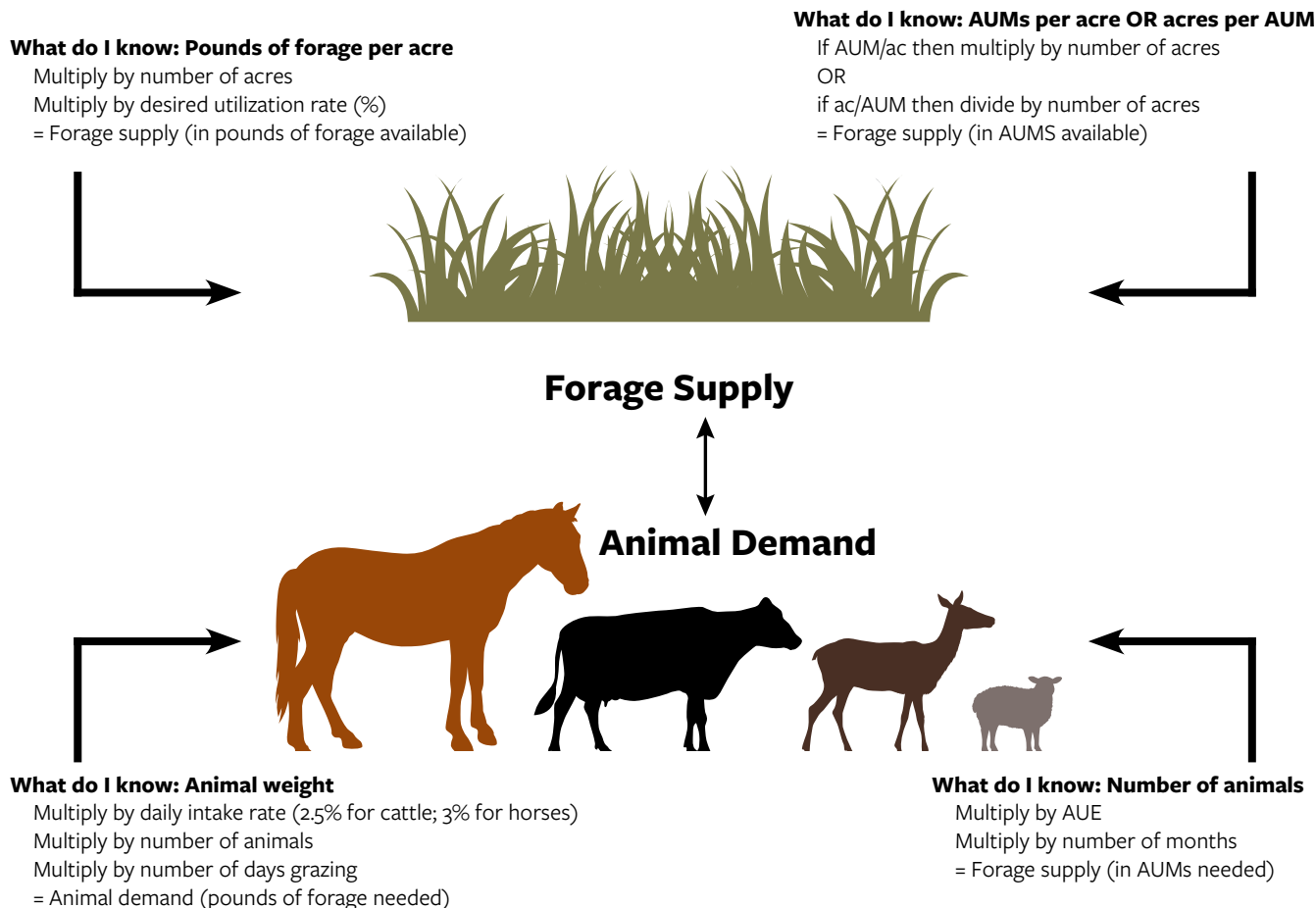


Figure 2. Flexibility of the AUM concept and relation to commonly known features of forage or livestock.

Grazing Plans

Range and livestock managers may find grazing plans to be useful management tools. Grazing plans are often mandatory for federal grazing allotments. The grazing plan will outline which animals, both class and numbers, will be in which pastures at a certain time. Knowing forage production estimates will be critical for setting the initial numbers. Permittees on federal allotments should make sure they understand the plan with the agency range conservationist in order to remain in compliance with the terms of the permit.

Grazing plans should include contingency, or alternate plans in the case of unforeseen events such as drought, fire, loss of lease, wildlife use, etc., that may reduce the forage supply planned for in the original grazing plan.

Plans will include where livestock will be at certain times and when and how they'll be moved to new pastures. Grazing plans should include a schedule of rotations for several years out. For instance, it is common practice for a pasture used earliest in the grazing season to be used last the following year.

Federal land grazing permittees should consult with their agency range conservationist to get ideas of what will need to happen with grazing management should something like a drought or fire occur. These contingency plans may include stocking rate reductions or delayed turn out dates that may not be welcome news to the livestock manager. However, knowing ahead of time will help the livestock manager plan for these inevitable events on western rangelands; this is true for both those grazing on public and private lands.

Grazing Leases (Per Head versus AUM Structured Leases)

Federal grazing permits usually use the AUM or head month (HM) concept to stock allotment; however, the permit's annual operating instructions may list a number of head of a specific animal class for a set grazing season. Make sure you and the range conservationist understand which method is being used. The allotment management plan will stipulate how many AUMs or number of head are

allowed. When using number of head, the permit will often stipulate a number and class of livestock such as 150 mature cows.

Important questions to ask the range staff may be:

- Can I alter the number of head and the length of the grazing season but maintain the same number of harvested AUMs?
- Could I alter the class of livestock (cow/calf pairs to yearlings) and still graze the same number of AUMs?
- Greater flexibility is possible when leasing private lands. But, whether interested in leasing out your pasture or leasing pasture from someone, understanding the AUM concept as described above is important.
- Are you going to charge or be charged on a per-head basis or a true AUM basis?
- What are the advantages/disadvantages to you of each system?
- Do both sides understand the AUM concept the same?

Leasing pasture to someone on a true AUM basis requires knowing the average weight of the grazing animals.

Conclusion

Remember that range management is an art and a science. Calculating forage production and stocking rates can be somewhat of a moving target given natural variation in the environment, across years, and within groups of livestock; however, basic information about livestock size and class and forage production will provide estimates that can approximate grazing management targets and how to meet grazing allotment utilization standards.

Livestock managers should view their initial forage production figures and stocking rate decisions as estimates that will need evaluation and possible modification based on conditions annually.

For Additional Information

“Harvest Efficiency in Prescribed Grazing” –
Shane Green and Brendan Brazee. https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_045468.pdf

Grazing Management for Sustainable Ranching –
Michael A. Smith. http://www.wyoextension.org/agpubs/pubs/MP111_14.pdf

“Determining Your Stocking Rate” –
Mindy Pratt and G. Allen Rasmussen.
https://digitalcommons.usu.edu/cgi/viewcontent.cgi?article=1992&context=extension_histall

Monitoring: A Tool for Effective Range Management – Michael A. Smith. http://www.wyoextension.org/agpubs/pubs/MP111_02.pdf

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