NebGuide

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Research-Based Information That You Can Use

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Introduction to Animal Unit (AU) Concepts for Production of Sheep and Goats

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The animal unit system is a tool that helps livestock producers optimize herd or flock grazing management. The system estimates forage availability for grazing, which allows producers to better match animal stocking rates with available pasture and rangeland resources. Correctly balancing these components of grazing systems contributes to well-fed livestock and healthy grazing lands.

Introduction

The *animal unit* (AU) system was created to help producers optimize grazing resources by providing a way to match the forage demands of livestock with forage availability. This improves the ability to make management decisions that provide the most benefit to both the grazing animals and the pasture and rangelands being grazed. This NebGuide introduces the AU system and its use of estimated forage availability on grazing land to determine appropriate forage resource utilization for sheep and goats.

Estimating forage consumption from bodyweight: The animal unit equivalent (AUE)

The AU system was originally created for the beef industry, so the fundamental unit of the system is based on the estimated average daily forage intake per lb. for grazing beef cattle. One 1,000-lb. beef animal is considered 1.0 *animal unit equivalent* (AUE), and each additional 100 lb. of bodyweight increases by 0.1 the AUE of the animal(s). Thus, a 1,200-lb. cow with a 200-lb. calf would be considered 1.4 AUE. Likewise, each 100 lb. less than 1,000 lb. would decrease by 0.1 the AUE, and thus two 450-lb. calves, which weigh 900 lb. together, would equate to 0.9 AUE. Although developed for beef cattle, this standard for AUE can be directly applied to other classes of ruminant livestock as well. For example, a mature sheep with a bodyweight of 200 lb. would count as 0.2 AUE, and therefore five 200-lb. ewes would be 1.0 AUE, which is the grazing equivalent of one 1,000-lb. cow because $0.2 \times 5 = 1.0$. Just as with cattle, the AUE is adjusted for sheep based on heavier or lighter bodyweights (e.g., a 300-lb. ram counts as 0.3 AUE, whereas a 100-lb. ewe lamb counts as 0.1 AUE).

It is reasonable to use the same bodyweight-based values for goats. A 100-lb. yearling kid counts as 0.10 AUE, a mature 150-lb. doe counts as 0.15 AUE, and a 200-lb. buck counts as 0.20 AUE. Because AUE are standard units among ruminant livestock, the grazing needs of sheep, goats, and cattle can also be estimated together. For example, ten 100-lb. sheep, five 50-lb. goats, and two 1,000-lb. steers grazing together would count as 3.25 AUE, because 3,250 lb. of ruminant livestock are present on the grazing lands.

Making these weight-based adjustments provides a more accurate estimate by accounting for the obvious differences in forage intake between larger and smaller animals. It is also important to note that AUE represents the *average* expected forage consumption for a sheep or goat of a specific size. The actual amount consumed may

vary among breeds or individual animals, and it can be affected by factors such as age, pregnancy, and the digestibility of the diet, which fluctuates by season. Understanding and accurately assigning AUE to animals based on their bodyweights, as illustrated in Example 1, is the first step in determining the appropriate stocking density of pastures and rangeland.

Example 1. How many AUE are in a flock of breeding ewes?

	Q1. How many are there?	A: 125 ewes				
	Q2. How big are they?	A: They average about 200 lb./ewe				
No. of animals		Average Bodyweight		AUE Adjustment (Always 0.001)		Total AUE
125	x	200	x	0.001	=	25

Estimating forage consumption for a 1-month period: The AUM

Once the AUE of a herd or flock has been calculated, the element of time spent on the grazing land can then be considered. This is critical, as forage regrowth typically occurs much slower than the rate at which it is consumed even with optimal rainfall, and each AUE will require more forage to be present if the land is expected to be grazed for longer periods of time. Therefore, the next step in matching animal demand with forage availability is to incorporate the amount of time in months that the herd or flock will remain on a pasture or rangeland. An *animal unit month* (AUM) is the estimated amount of forage needed to maintain 1.0 AUE for one month (i.e., 30 days). The actual amount an animal consumes may vary among breeds, forage types, seasons, and environments, but a good general estimate is 780 lb. of air-dried forage for each AUM. (Note: the air-drying process is discussed below. Alternatively, estimated air-dried percentages are available online for some forage types.) Knowing the AUM for a group of animals allows producers to plan their grazing strategies more effectively by estimating how long a particular grazing plot can support a specific number of animals. AUM values are calculated by simply multiplying the AUE of a herd or flock by the number of months the animals will be allowed to graze, as illustrated in Example 2. Some producers may prefer to calculate their herd or flock's grazing needs in *animal unit days* (AUD), rather than in AUM. Because an AUM is the amount of forage needed to support 1 AUE for 1 month (i.e., 30 days), an AUD is simply AUM/30 days, and thus is equivalent to 26 lb. of air-dried forage (i.e., 780 divided by 30).

Example 2. How much forage is required to feed a flock of breeding ewes (25.0 AUE) for 5

	Q1. What is	A: 25.0 AUE (Estimated in Example 1.)				
	Q2. How many	A: 5.0 months				
No. of AUE		Number of months		AUM Demand		
25.0	x	5.0	=	125.0		

These calculations will provide good estimates for initial stocking rates. Of course, rangelands should be monitored periodically, and adjustments should be made if necessary.

Estimating Forage Availability

Once the AUM demand of a herd or flock has been calculated, it can then be compared to the estimated amount of forage available for grazing on the pasture or rangeland to be utilized. Available forage can be easily estimated using the procedure described briefly in Table 1 and detailed in the University of Nebraska–Lincoln (UNL) BeefWatch article *Calculating Forage Demand and Forage Availability*, available at the following link: https://beef.unl.edu/beefwatch/calculating-forage-demand-and-forage-availability.

Approximations of forage production by vegetative zones, range site category, and predominant forage species are provided in detail in the UNL Extension Circular EC86–113, *A Guide for Planning and Analyzing a Year-Round Forage Program*, which is available at the following link: https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=2617&context=extensionhist. These values may be useful for quick reference, but estimates collected by producers from their own pasture and range will be a better representation of true forage production of a specific site.

Once forage availability for a pasture has been determined in lbs./acre, this can be converted to an estimate of *total* forage availability (AUM/acre) by dividing lb./acre by 780 lb./AUM. Multiplying the AUM/acre production value by the number of acres in a pasture gives the total AUM forage availability for the pasture, as demonstrated in Example 3. Note that this total does not equate to the amount that can be *sustainably* harvested.

Example 3. The per acre forage production of a certain sized pasture is known from previous haying records. How much total forage is available?

	Q1. How much forage is	A: Records show 1,170 lb./ac or 1.5 AUM/ac (1,170/780 = 1.5)				
	Q2. How many acres total?	A: 80 acres				
Forage production		Number of acres		AUM total available forage		
1.5	x	80	=	120		

Table 1. Estimating forage availability on grazing lands.

1.	A small hoop or PVC square of known area (e.g., a 2 x 2 ft. square hoop = 4 square ft.) is tossed randomly over a portion of pasture to be sampled.
2.	All appropriate forage plant material within the hoop or square is harvested by clipping at ground level.
3.	Clipped forage is collected into a paper or cloth sack.
4.	Repeat steps 1–3 in several different random areas to produce a representative sample of the entire grazing land. Include both swales and upland areas.
5.	Allow the sack to sit in a warm, dry area for one week, which will air dry the plant material. (Air-dried forage contains about 90% dry matter and 10% water.)
6.	Record the forage weight. (Weight of the full sack—weight of the empty sack.)
7.	Divide the forage weight by the total area from which it was collected. This is the estimated forage density for the pasture in lb./square feet. (Total area = the area of the hoop x number of sampling sites.)
8.	Because 1 acre = 43,560 square feet, multiplying the forage density by 43,560 provides an estimate of lb. forage per acre.

There are many reasons to avoid grazing forage resources beyond the threshold of what may be sustainably removed from a pasture. Chronic overgrazing can irreversibly damage the health and plant diversity of the pasture and is thus not advisable. When little or no plant mass is left above the ground, post-grazing regrowth must draw from energy stores in the roots. This depletion weakens plants and renders them less able to withstand further stress from drought, temperature changes, or future grazing until energy stores can be built back up, which can take months or even years. Repeated overgrazing can effectively kill off desirable forage species, exposing soil to greater risk for erosion and reducing its ability to capture rainwater. It may also shift the plant population toward less desirable species, including noxious weeds. Therefore, producers should typically stock pastures with a total AUM that will consume no more than about 50% of the estimated total forage. This is commonly known as the *take half, leave half* rule. The appropriate ratio of AUM relative to forage availability can also vary based on the time of year, as grazing during peak vegetative growth can deplete root nutrient stores and impair regrowth to a greater extent than grazing after peak vegetative growth. Producers should also consider that some of the available forage will be lost to non-consumptive waste (e.g., trampling on un-grazed forage) as well as to acts of nature (e.g., consumption by wildlife or insects) (Fig. 2, courtesy of UNL Professor Jerry Volesky). In fact, as little as one-half of the forage removed from a pasture is actually eaten by the livestock. Thus, planning an annual stocking rate equal to about 25% of the estimated total forage may be appropriate to preserve the long-term health of the pasture for future grazing. This

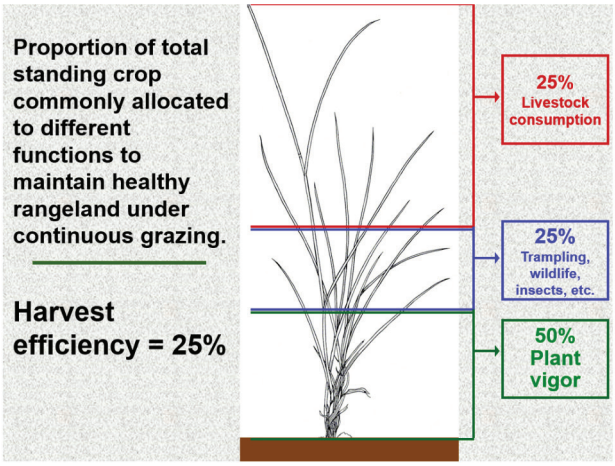

Figure 1. Relative proportions of forage utilization during appropriate livestock grazing.

harvest efficiency (HE) value can vary due to influence from factors beyond stocking density, such as forage palatability, forage growth stage, and management preferences. In general, HE is lowest in continuous grazing systems and greatest in management-intensive grazing systems. However, a starting HE of 25% is usually reasonable.

Examples 4a and 4b use a grazing area of known size, a fixed time period for grazing, estimated forage availability,

Example 4a. How many 150 lb. goats can be grazed for one month in a 40-acre pasture? The appropriate stocking density was determined to be 0.6 AUM/ac.

	Q1. What is the appropriate stocking rate?	A: 0.6 AUM/ac (2.4 AUM/ac estimated production x 0.25 HE = 0.6)
	Q2. How many acres total?	A: 40 acres
	Q3. What is forage demand/goat?	A: 0.15 AUE/goat

Calculation 1: Find the amount of forage available

Area		Stocking Rate		AUM Forage Available
40	x	0.6	=	24

Calculation 2: Find the amount of forage demand per animal

AUE/goat		Months		AUM forage demand per goat
0.15	x	1.0	=	0.15

Calculation 3: Determine how many animals the availble forage will support

AUM Forage Available		AUM forage demand per goat		# of goats
24.0	÷	0.15	=	160

Example 4b. How many 150 lb. goats can be grazed for three months in a 40-acre pasture? The appropriate stocking density was determined to be 0.6 AUM/ac.

	Q1. What is the appropriate stocking rate?	A: 0.6 AUM/ac (2.4 AUM/ac estimated production x 0.25 HE = 0.6)
	Q2. How many acres total?	A: 40 acres
	Q3. What is forage demand/goat?	A: 0.15 AUE/goat

Calculation 1: Find the amount of forage available

Area		Stocking Rate		AUM Forage Available
40	x	0.6	=	24

Calculation 2: Find the amount of forage demand per animal

AUE/goat		Months		AUM forage demand per goat
0.15	x	3.0	=	0.45

Calculation 3: Determine how many animals the availble forage will support

AUM Forage Available		AUM forage demand per goat		# of goats
24.0	÷	0.45	=	53

and a HE of 25% to determine the number of animals that can graze the pasture without long-term damage to the forage resource. (Note that the fixed time period used for these examples is for demonstration purposes. Producers would typically adjust the duration of grazing based on periodic assessments of forage utilization so as to avoid overutilization or underutilization.)

Example 4 describes a grazing area of fixed size with a fixed grazing period and flexible flock/herd size. However, AUM calculations can also be used to determine how much grazing land is needed for a specific number of animals (i.e., flexible grazing area to support a fixed flock/herd size). This scenario is illustrated in Examples 5 and 6.

From the information provided by the calculations in Example 6, the producer can easily compare pasture lease costs to the costs of purchasing 11.7 tons of hay (air-dried basis) to determine the better option. The UNL Center for Agricultural Profitability provides a summary of land valuation and cash rental rates, which provide useful information for producers making such decisions (go to https://cap.unl.edu/realestate). Likewise, the information learned from the calculations in Examples 5 and 6 may lead the producer to subdivide the 100-acre pasture with hot wire and graze cattle or horses on the 60 surplus acres. These are but a few illustrations of how the AU system can improve decision-making power for producers.

Another consideration when implementing the AU system is the diet selectivity of sheep and goats. Unlike cattle, which primarily consume grasses, sheep and goats eat substantial amounts of leafy plants (i.e., forbs) and woody plants (i.e., browse). When allowed free choice, sheep will select approximately 60% grasses, 30% forbs, and 10% browse. Goats will select approximately 20% grasses, 20% forbs, and 60% browse. This selectivity means that producers should adjust estimates of forage availability by considering what plant species should/should not be considered forage when clipping forage samples (i.e., what plants do/do not *go in the sack*). More information on this topic can be found in the UNL Extension article *Grazing Preferences of Sheep and Goats*, which is available at the following link: https://extension.unl.edu/statewide/lincolnmcpherson/Grazing%20Preferences.pdf.

Example 5. If a 100-acre pasture produces 3 AUM/acre, how many acres are needed to support seventy-five 200-lb. sheep for 2 months? Use an HE of 0.25.

	Q1. How many AUE/sheep?		A: 0.20			
	Q2. What is total forage demand?		A: Calculation 1 below			
	Q3. What is total available forage?		A: Calculation 2 below			
Calculation 1: Find the amount of forage demand						
# of sheep	x	AUE/animal	x	months		AUM Forage Demand
75	x	0.20	x	2	=	30
Calculation 2: Find the amount of forage available						
		AUM/ac production		HE		AUM/ac Forage Available
		3.0	x	0.25	=	0.75
Calculation 3: Determine the number of acres needed						
		Total AUM Forage Demand		AUM/ac Forage Available		Total Acres
		30	÷	0.75	=	40

Example 6. Suppose this producer wanted to know if it was cheaper to lease pasture or buy hay for their animals. How much hay would be required to maintain these same 75 sheep for 2 months? Recall that 1 AUM = 780 lb. air-dried hay.

	Q1. How many AUE/sheep?		A: 0.20			
	Q2. What is total forage demand?		A: Calculation 1 below			
	Q3. What is total demand in lb. and tons?		A: Calculations 2 and 3 below			
Calculation 1: Demand in terms of AUM does not change						
# of sheep	x	AUE/animal	x	months		AUM Forage Demand
75	x	0.20	x	2	=	30
Calculation 2: Convert from AUM to lb. of air-dried hay						
		AUM demand		AUM to lb. conversion factor		lb. air-dried hay
		30	x	780	=	23,400
Calculation 3: Convert from lb. to tons of air-dried hay						
		lb. air-dried hay		lb. to tons conversion		Tons air-dried hay
		23,400	÷	2,000	=	11.7

Conclusion

The AU system is a valuable tool that allows sheep and goat producers in Nebraska and other states to best utilize forage resources by matching their grazing resources with the forage demands of their animals. The system can help to determine if a pasture or rangeland has adequate forage to support a fixed-size flock, and it can also help to determine how many head can be safely turned out to graze a pasture for a set amount of time without short-term or long-term damage to the land. Although these calculations can feel daunting at first, experience and repetition are the best teachers. The examples provided in this guide can help prevent mistakes by showing producers how to keep track of the known values, the values being calculated, and the units. Keeping accurate records is important for all agricultural producers, and tracking forage production and utilization is an effective way to inform future management decisions. UNL Extension professionals have developed a *Grazing and Hay Records* template to help producers keep forage records. It is available at the following link: https://extensionpublications.unl.edu/assets/pdf/ec165.pdf. Additionally, the *Using the Grazing Records Spreadsheet* webinar provides an overview and explanation of the template and is available at the following link: https://beef.unl.edu/using-grazing-records-spreadsheet.

Additional Resources from UNL BeefWatch and UNL Extension

Budget Templates Updated for Sheep and Goat Enterprises: https://beef.unl.edu/beefwatch/2021/budget-templates-updated-sheep-and-goat-enterprises

Calculating Forage Demand and Forage Availability: https://beef.unl.edu/beefwatch/calculating-forage-demand-and-forage-availability

Make Informed Range and Pasture Management Decisions: https://beef.unl.edu/beefwatch/make-informed-range-and-pasture-management-decisions

Understanding Animal Unit Month (AUM) and Use in Range Management: https://beef.unl.edu/aum-rangemanagement

Range Judging Handbook and Contest Guide for Nebraska: https://extensionpubs.unl.edu/publication/9000016366706/range-judging-handbook-and-contest-guide-for-nebraska/

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