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EC86-113 A Guide for Planning and Analyzing a Year-Round Forage Program

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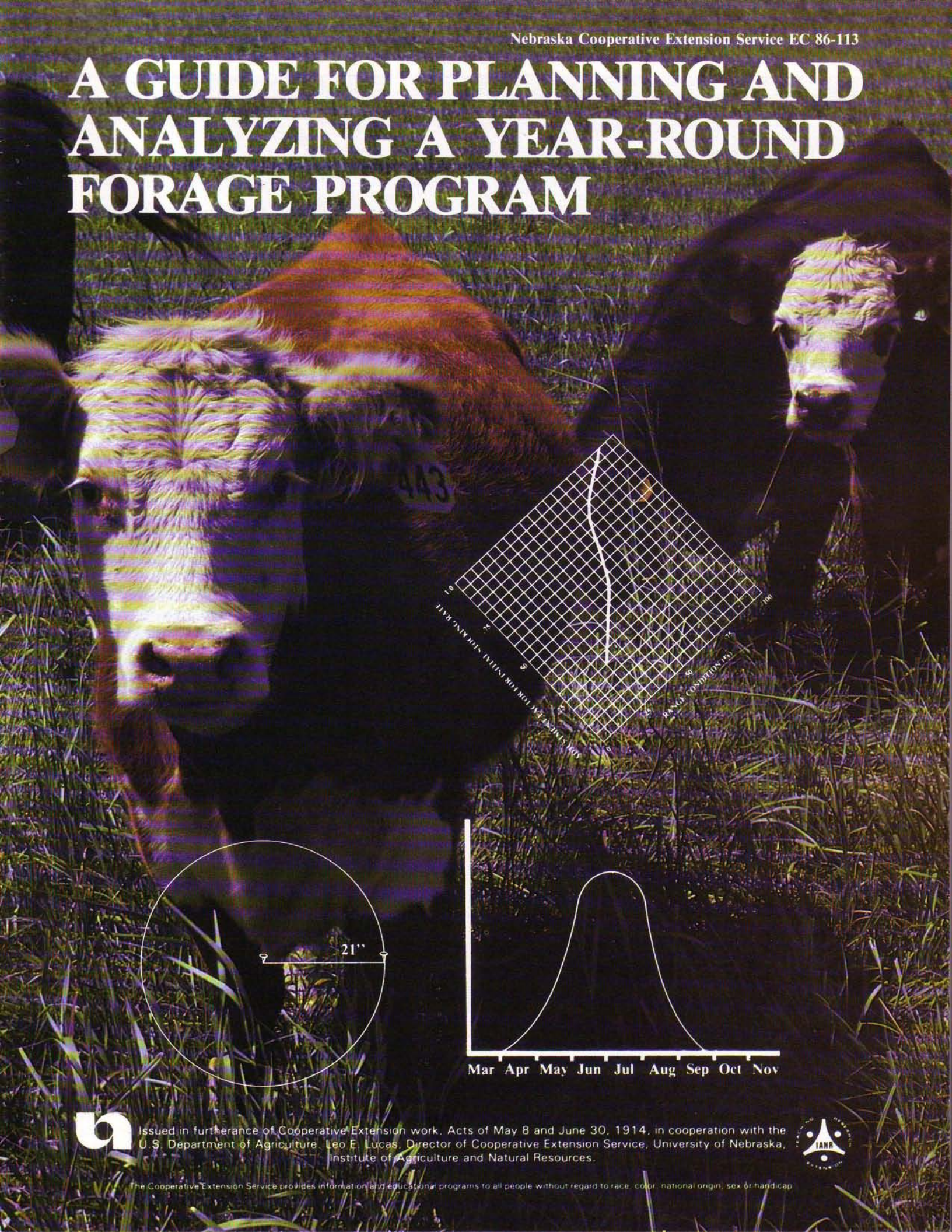

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A GUIDE FOR PLANNING AND ANALYZING A YEAR-ROUND FORAGE PROGRAM

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FOREWORD

Efficient grazing management programs cannot succeed without proper stocking rates. However, proper stocking rate alone will not insure a successful grazing program. Successful grazing management only occurs when all factors affecting production are manipulated properly: season of use; kind, class, and/or combination of animals; grazing distribution; grazing program; fertilization; pest control; and water management as well as stocking rate. The following suggestions are a guide to initial planning of new pastures and the modification of existing grazing programs. Contact your local Cooperative Extension Service or Soil Conservation Service offices for further help to develop and implement a grazing and total year-round forage program.

Balancing forage plant and livestock needs is essential for successful grazing programs. The **grazing capacity** of a pasture is the amount of forage available for grazing; the biological potential of the forage resource. This forage is used most efficiently when it is balanced by an equal demand for forage (**stocking rate**). Stocking rate is a function of size and number of animals, and the length of the grazing period. The balance between available forage and forage demand is fragile and constantly changing.

Past and current management and environmental conditions such as temperature, moisture, soil condition, forage species, fertilizer, pests, and season of the year all affect plant production. Forage intake is influenced by the size and type of animal, production level, reproduction stage, past nutritional regime, forage quality, water availability and quality, supplements, and environmental stresses. As a result, each farm and ranch is unique and requires adjustments to the suggestions given here.

ESTIMATING LIVESTOCK FORAGE DEMAND

Animal Unit

A common unit of measurement is needed that can estimate both the amount of forage demanded by livestock (stocking rate) and the amount of forage available (grazing capacity) in a pasture. This is accomplished by first defining a "standard animal" to adjust for differences in forage demand between kinds and classes of livestock.

The **animal unit** (AU) defines forage intake on the basis of a standard animal. In Nebraska the most practical "standard animal" is the cow-calf pair. This guide defines the **animal unit** as a 1000-pound cow of above average milking ability with a calf less than 3 to 4 months postpartum. An **animal unit month** (AUM) is the amount of forage required to sustain one AU for one month. The cow-calf pair described above will consume about 680 pounds of forage dry matter (750-780 lbs air dry forage) each month. Therefore, all forage demand and forage availability estimates will be based on this monthly 680-pound dry matter intake by the standard animal. The AUM can then be defined as 680 pounds of dry matter.

Animals consuming more or less forage than the standard animal due to differences in size, type, production level, etc. are assigned AU values based on their intake relative to the standard animal (Table 1).

For example, yearlings consume about 480 pounds of forage dry matter per month. As a result, they are assigned 0.7 AU (480 lbs/steer month ÷ 680 lbs/AUM). Mature bulls require more feed than a cow-calf pair and are considered to be 1.5 AU. After a calf is three months of age, forage intake increases and becomes more important than milk to its nutrition. These calves require 0.3 AU of forage monthly until weaning at approximately 400 pounds.

Not all livestock are the same size or weight as the typical animals described. Animal weight variations require adjustments in AU value equal to 0.1 AU for every 100 pounds of liveweight that the animal differs from the weight typical for its classification. Thus, exotic, cross-bred cow-calf pairs with cows that weigh 1,200 pounds are assigned 1.2 AU if they milk well and have a young calf (less than 3-4 months). Calves that wean heavier than 400 pounds should be adjusted in a similar manner for the period from 3-4 months postpartum to weaning.

Using Animal Units to Estimate Forage Needs

To start determining correct stocking rates, calculate the amount of forage needed by the livestock. Multiply the number of AU by the number of months grazing (AU x M = AUM). The AUM describes the expected forage intake during that grazing period. Forage demand during parts of the grazing period can also be determined as shown in the following example.

Example: 100 cows and calves to graze from May 1 to September 30, average calving date of April 1 for cows weighing 1000 pounds and milking well;
100 steers (12 to 17 months of age) to graze from May 1 to July 15

Total Forage Demand:

Cow-Calf Pairs: 100 pairs x 1.0 AU/pair x 2 months (until July 1 when calves become 3 months old) = 200 AUM
100 pairs x 1.3 AU/pair x 3 months (from July 1 until September 30) = 390 AUM

Steers: 100 steers x .7 AU/steer x 2.5 months = 175 AUM

TOTAL = 200 + 390 + 175 = 765 AUM

Forage Demand by Month

	AUMs				
Livestock	*May*	*June*	*July*	*Aug.*	*Sept.*
Cow-calf pairs	100	100	130	130	130
Steers	70	70	35	0	0
TOTAL	170	170	165	130	130

Table 1. Animal unit values (AU) for different kinds and classes of livestock and wildlife. The standard for this guide is based on forage intake of a spring calving cow (1000 lbs, above average milking ability) and her calf (3-4 months). Estimates are based on expected forage intake when forage quality is adequate. Consequently, these values are primarily intended to be used during the growing season. Fall, winter, and early spring grazing are generally supplemented with hay and/or protein to meet the nutrient requirements of the animal. Since the forage is generally not actively growing during these periods, livestock numbers must be managed to maintain adequate plant residue and minimize mechanical damage.

Kind/class of animal	*AU*
Cattle	
Cow (1000 lb) and calf (spring calving, above average milking ability, first 3-4 months postpartum)	1.00
Calf (spring calving, 3-4 months postpartum to weaning)	0.30
Replacement heifers (24-36 months)	1.00
Cow (1000 lb) non-lactating	0.90
Two-year old steers	0.90
Yearling cattle (18-24 months)	0.80
Yearling cattle (12-17 months)	0.70
Weaner calves (under 12 months)	0.50
Young bulls (12-24 months)	1.20
Bulls (24-60 months)	1.50
Horses	
Yearlings	0.75
Two-year old horses	1.00
Mature light horses	1.25
Sheep	
Sheep (mature)	0.20
Lamb (weaned to yearling)	0.12
Lamb (yearling)	0.15
Ram	0.25
Goats	
Goat (mature)	0.15
Kid (yearling)	0.10
Wildlife	
Deer (white tailed, mature)	0.15
Deer (mule, mature)	0.20
Antelope (mature)	0.20
Bison (cow, mature)	0.90
Bison (bull, mature)	1.50
Bison (herd average)	1.20
Elk	0.60

ESTIMATING ANNUAL FORAGE PRODUCTION

Grazing capacities can't be determined for any forage resource without measuring yield. Annual forage yield is usually measured on **ungrazed** plants at the end of the growing period. To measure this yield, a circle using a 21-inch wire tied to a large nail at each end is commonly marked off (Figure 1). All of the current year's forage plant growth in a circle is clipped at ground level. Forage is dried in an oven between 190 and 210°F for 48 hours and weighed in grams (453.6 grams per pound). The weight in grams is multiplied by 10 to get pounds per acre. For example, if 136 grams of dry forage were clipped from a circle, there are 1,360 pounds of forage per acre present (136 x 10 = 1,360).

Several circle plots are used for each pasture to estimate average forage production. Since forage production varies with different range sites and different management inputs, a new set of circle plots should be clipped for each range site within a pasture.

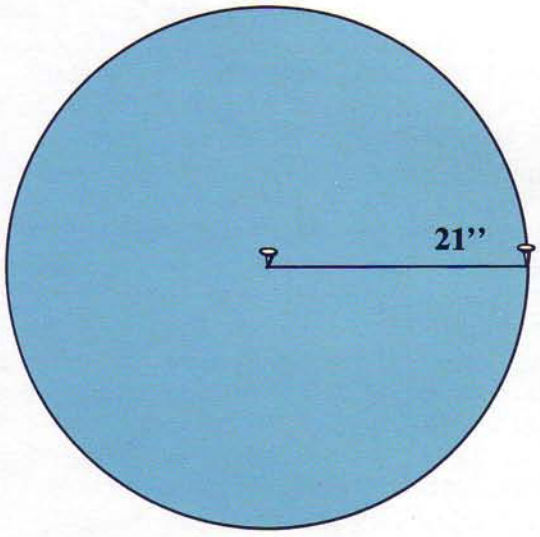


Figure 1. How yield of forage can be determined.

You may want to measure the forage yield yourself for specific pastures. Several agricultural supply stores sell scales that measure in grams. Some diet scales or fish scales can be used, also. Place your clipped sample from a circle plot in a small, cloth or burlap bag and let it air dry for a week or until dry. Weigh it again (don't forget to substract the weight of an empty bag) and multiply the weight by 0.88 to obtain a dry matter weight. During very humid or very dry conditions the 0.88 adjustment factor to convert from air dry to dry matter may produce incorrect results.

End-of-season forage yields can sometimes be misleading. Depending on the species present and their diversity, some grazable forage will grow, die and fall to the ground, or be consumed by insects or other herbivores before the season ends. This forage will not be available for weighing using the end-of-season forage yield method. In addition, forage plants produce different amounts of grazable forage during the growing season when they are grazed compared to when they are ungrazed. Grazing may also stimulate more vegetative leaf growth than nonuse, and leaves are more desirable to livestock than mature stems. Thus, yield measurements of ungrazed plants several times during the season often provide more accurate estimates of total available forage than will end-of-season harvests.

Abnormally high or low forage yields, due to weather, fertilization, prior management, etc., will result in higher or lower estimates of grazing capacity from this method. Average forage production over several years is needed to accurately calculate an initial grazing capacity.

ESTIMATING SUGGESTED INITIAL STOCKING RATE

Proper stocking is achieved when grazing capacity equals stocking rate. If grazing capacity (forage availability) is less than stocking rate (forage demand), livestock will consume plant material needed to maintain plant vigor and soil cover. Excessive plant use during the growing season can reduce root growth and deplete root energy reserves. If continued for several years, excessive use will weaken desirable plants and lower forage production. Livestock numbers may need to be reduced to maintain plant health. Excessive use during plant dormancy will not affect root growth, but snow cover, trampling, plant desiccation, and subsequent stand vigor may suffer. If forage availability exceeds forage demand, forage will be wasted and become coarse, mature, and less nutritious. Animal numbers may need to be increased, grazing begun earlier, and/or some areas cut for hay to use forage efficiently.

Initial Recommended Stocking Rate Guides

Native Range

Native rangelands differ in their ability to produce specific kinds, proportions, or amounts of vegetation, a factor recognized in the range site classification scheme. In Nebraska, 24 different range site names have been selected that have soil groupings of similar production potential. The state is also divided into 4 vegetative zones to adjust for precipitation differences that affect plant production (Figure 2). Specific range sites are identified by both a range site name and a vegetative zone, for example: sands, Vegetative Zone II.

Figure 2. Nebraska Vegetative Zones.

Table 2 lists initial recommended stocking rates for the different range sites in each vegetative zone when they are at optimum production (100 percent range condition). Since grazing capacity (AUM/acre) is equal to stocking rate (AUM/acre) when stocked properly, Table 2 also represents grazing capacity under those conditions. These values assume a season-long, continuous grazing on range in excellent range condition. The range is grazed to the recommended intensity of leaving 50 percent of the vegetation on the plant to retain plant vigor and assumes about 25 percent of the total yield is lost to wastage, trampling, and other herbivores (Figure 3).

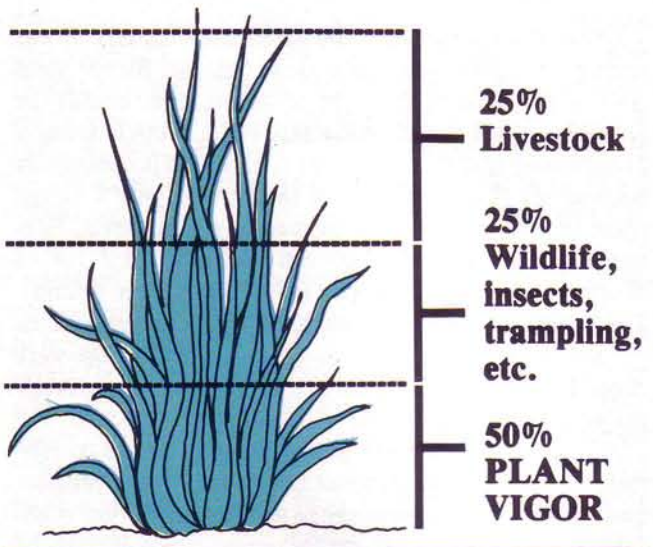


Figure 3. Plant utilization by weight assuming continuous, season-long grazing (i.e. take half and leave half).

Table 2. Suggested initial recommended stocking rates for Nebraska range in 100% range condition (AUM/acre).[a]

RANGE SITE NAME	Vegetative Zone I	II	III	IV
Wet land (WL)	1.8	2.0	2.1	2.2
Wet subirrigated (WS)	1.7	1.8	1.9	2.0
Subirrigated (Sb)	1.5	1.6	1.7	1.8
Saline subirrigated (SS)	.8	.9	1.0	1.2
Silty overflow (SiO)	.8	.9	1.0	1.2
Clayey overflow (CyO)	.5	.7	1.0	1.2
Silty lowland (SiL)	.8	.9	1.0	1.2
Sandy lowland (SyL)	.8	.9	1.0	1.2
Saline lowland (SL)	.5	.7	.9	—
Savannah (Sv)	.3	.5	.6	—
Sandy (Sy)	.5	.7	.9	1.0
Sands (Sa)	.5	.7	.9	1.0
Choppy sands (CS)	.4	.6	.7	—
Clayey (Cy)	.4	.6	.9	1.0
Silty (Si)	.5	.7	.9	1.0
Limy upland (LiU)	.4	.6	.7	.9
Saline upland (SU)	.2	.3	—	—
Shallow clay (SwC)	.3	.5	.7	—
Shallow limy (SwL)	.3	.5	.7	.8
Shallow to gravel (SwG)	.3	.4	.6	.8
Shallow sandy (SwS)	—	—	—	.8
Dense clay (DC)	—	—	—	.9
Thin loess (TL)	—	.4	.6	.8
Panspots (Ps)	.2	.3	—	—

[a]Values taken from the SCS Nebraska Technical Guide (Section II-E-I). Adjust stocking rate recommendations for native range with range condition and grazing management adjustment factors.

Seeded Pasture

Pastures can contain improved grass or legume variety, or grass-legume mixtures that often receive intensive management, which may include annual fertilization, irrigation, weed control, and/or periodic renovation. Table 3 lists the recommended stocking rate (AUM/acre) for commonly used forages in each vegetative zone. These values assume a high level of management, with intensive grazing, adequate moisture, and fertilization. The range of values illustrate the soil variability within these classifications.

Adjusting Stocking Rate of Native Range According to Range Condition

Range condition estimates how closely the existing vegetation resembles climax vegetation expressed as a percent. Climax vegetation is the vegetation that exists when climate, plants, and soils are in a dynamic equilibrium and represent natural potential. Climax vegetation is used as the standard for native range because climax plants are often the most productive plants for grazing use. See EC 84-109, *Range Judging Handbook for Nebraska*, for instructions on determining range condition.

As species diversity of native perennial plants increases, range condition increases, which results in higher forage yields and livestock performance. Simple linear adjustments of recommended stocking rate based on actual range condition often underestimate available forage, particularly in the higher range condition

Table 3. Suggested initial recommended stocking rates for seeded pasture, seeded annuals, crop residues and hay aftermath (AUM/acre).

SPECIES	RANGE SITE NAME	Vegetative Zone I dry	I irr	II dry	II irr	III dry	III irr	IV dry	IV irr
		SEEDED COOL-SEASON GRASS PASTURE (dryland, irrigated)[a]							
Intermediate wheatgrass	SiL	1-2	11-12	3-4	11-12	4-5	11-12	5-8	10-11
	Si	1-2	6-12	1-3	6-12	1-4	6-12	2-6	6-11
	LiU	—	8-10	1-2	8-10	2-3	8-10	3-5	8-10
	Cy	1-2	8-9	1-2	8-9	2-3	8-9	3-4	8-9
	Sy	—	10-12	2-3	10-12	3-4	10-12	4-5	10-11
	Sa	0.5-1	8-10	2-3	8-10	2-3	8-10	2-4	7-9
Orchardgrass-Smooth brome mix	SiL	—	11-13	—	11-13	4	11-13	6	11-13
	Sb	—	—	—	—	3-4	—	5-6	—
Garrison creeping foxtail	SiL	—	11-13	—	11-13	—	11-12	—	10-12
	Sb	4-5	—	4-5	—	3-4	—	3-4	—
	CyO	2	—	2-3	—	3-4	—	4-5	—
Four-way[b] grass mix		—	12-13	—	12-13	—	12-13	—	11-12
		LEGUME/COOL-SEASON GRASS (50:50)[a]							
Alfalfa-grass mix	SiL	2	11-12	3-4	12-13	5	12-13	6-7	12-13
	Si	—	6-12	1-4	6-12	1-5	6-12	2-6	9-12
	LiU	—	9-10	—		4	10-11	5-6	10-12
	Cy	—	9-10	—	9-11	4-5	10-11	4-5	10-12
	Sy	—	10-12	3-4	10-12	4-5	11-12	6-7	11-13
	Sa	—	8-10	3-4	8-10	3-4	9-12	3-5	10-13
	Sb	2-3	9-11	3-4	9-11	3-4	10-11	6-7	10-11
Red clover-grass mix	Sb	1-2	—	2-3	—	3-4	—	4-5	—

classes. Thus, the response curve in Figure 4 was developed to help adjust recommended stocking rate according to range condition. It assumes proper grazing management.

To determine the appropriate stocking rate for continuous, season-long grazing use the following equation:

Proper Stocking Rate = Recommended Stocking Rate (100 percent range condition) (from Table 2) x Range Condition Adjustment Factor (from Figure 4).

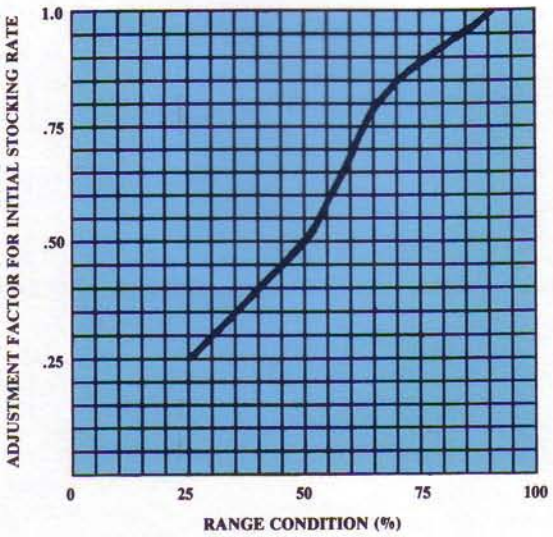
Example: Vegetative Zone = II
Range site name = sands
Range condition = 75 percent

Recommended stocking rate for continuous, season-long grazing = .7 AUM/acre (initial recommended stocking rate) x .9 (Range Condition Adjustment Factor from Figure 4) = .63 AUM/acre.

Adjusting Stocking Rate of Seeded Pasture According to Management

Fewer AUM s will be available for grazing from pastures used at less than optimum intensity. Multiply values from Table 3 by the numbers in Table 4 to adjust for less intensive management. For example, the stocking rate for smooth brome (silty, Vegetative Zone IV) grazed season-long without fertilization would only be

Figure 4. Stocking Rate Adjustment Chart



Bold numbers represent management areas:

Area 1: (0-25%) When range condition is this low alternatives to grazing management should be evaluated.

Area 2: (26-50%) In this area the stocking rate is conservative.

Area 3: (51-75%) This is a transition area between conservation SR and a full SR for maintenance of range condition. In this area one may want to deviate from the suggested adjustment factor depending upon range trend, grazing method, the management skills of the producer, or other factors.

Area 4: (76-100%) There is a full stocking rate in this area which should allow for maintenance of the range condition.

Table 3 (continued).

SPECIES	*RANGE SITE NAME*	*Vegetative Zone* I	II	III	IV
		SEEDED COOL-SEASON GRASS PASTURE (dryland)[a]			
Smooth brome	SiL	—	2-3	4-5	5-8
	Si	—	1-3	1-4	2-6
	LiU	—	—	2-3	3-5
	Cy	—	—	2-3	3-4
	Sy	—	2-3	3-4	4-5
	Sa	—	—	2-3	2-4
	Sb	3-4	3-4	3-4	5-6
Reed canarygrass	Sb	4-5	4-5	4-5	5-6
	CyO	—	2-3	3-4	5
Tall fescue	CyO	2	2-3	3-4	5
	SS	—	1-2	1-2	2
Tall wheatgrass	SS	1-2	1-2	2	2
Western wheatgrass	SS	1	1-2	1-2	—
Crested wheatgrass[c]	Si	.7	—	—	—
	Cy	.7	—	—	—
		SEEDED WARM-SEASON GRASS PASTURE (dryland)[a]			
Switchgrass	SiL	—	3-4	4-5	5-8
	Si	—	2-3	2-4	3-6
	LiU	—	1-2	3-4	4-6
	Cy	—	1-2	3-4	4-5
	Sy	—	2-3	4	4-5
	Sa	—	—	3	3-4
	Sb	1-2	3-4	3-4	5-8
	SS	—	1-2	1-2	3

.8-2.4 AUM/acre. Recommended stocking rate = 2-6 AUM/acre (Table 3) x .4 (Management adjustment factor for seeded pasture, Table 4) = .8-2.4 AUM/acre.

Seasonal Distribution of Forage Quantity and Quality

Different forages have different rates and patterns of growth. Forage quality or feed value also changes throughout the growing season according to temperature, moisture, and plant maturity.

As grazing programs are developed, seasonal distribution of growth and forage availability and of forage quality should be balanced with the seasonal forage and nutrition demands of livestock. Livestock production will be optimized only when both quantity and quality of forage is adequate.

Grazing generally should not begin until a pasture accumulates sufficient forage and the growth rate is rapid enough to supply adequate forage for the livestock. In addition, grazing areas should be stocked

Table 4. Adjustment factors for the suggested initial recommended stocking rates of seeded pasture, seeded annuals, crop residues and hay aftermath (Table 3).

	Forage				
Grazing Management/ Production Inputs	*Cool-season grasses and/or legumes*	*Warm-season grasses*	*Annual grasses*	*Crop residues*	*Hay aftermath*
Continuous, season-long grazing with few production inputs	.4	.5	.5	.7	.7
Simple rotation[a] with limited production inputs	.7	.8	.8	.9	.9
Complex rotation[a] with high production inputs	1.0	1.0	1.0	1.0	1.0

[a] Simple rotation has one occupation per pasture per grazing season and a complex rotation has multiple occupations per pasture per grazing season.

Table 3 (continued).

		Vegetative Zone			
SPECIES	*RANGE SITE NAME*	*I*	*II*	*III*	*IV*
		SEEDED WARM-SEASON GRASS PASTURE (dryland)[a]			
Big bluestem	SiL	—	2-3	3-4	4-8
	Si	—	1-2	1-3	2-6
	LiU	—	1	2-3	3-5
	Cy	—	1	2-3	3-4
	Sy	—	1-2	3	3-4
	Sa	—	—	2	2-3
	Sb	2-3	2-3	2-3	4-7
	SS	—	1	1	2
		SEEDED ANNUALS[c]			
Rye		1.4	2.2	2.0	2.4
Winter wheat		1.0	1.0	1.2	1.2
Oats		—	1.0	1.8	2.4
Sudan (dry)		2.0	3-4	4-5	6-7
Sudan (irr)		8.0	10.0	10.0	10.0
		CROP RESIDUES (grazed)[c]			
Cornstalks (dry)		—	1.5	2.0	2.5
Cornstalks (irr)		1.5-2.5	1.5-2.5	1.5-2.5	1.5-2.5
Sorghum (dry)		1.0	1.5	1.5	2.0
Sorghum (irr)		—	2.0	2.0	2.0
Wheat		1.0	1.0	1.0	1.0
Beet tops		2.5	—	—	—
		HAY AFTERMATH[c]			
Native meadow		.3	.5	.5	.5
Alfalfa (irr)		1.5	2.0	2.0	2.5
Alfalfa (dry)		.3	.5	1.0	1.0
Alfalfa-grass (irr)		2.5	3.0	3.0	3.0
Alfalfa-grass (dry)		.5	1.0	1.0	1.5
		OTHER[c]			
Kentucky bluegrass	Si	—	—	1.0	2.0

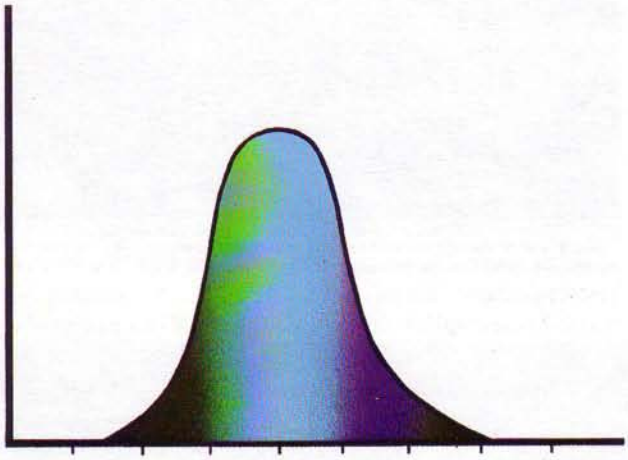
[a] Values adapted from the SCS Nebraska Technical Guide (Section II-K). Stocking rates provided for seeded pastures by soil suitability group assuming a high level of management. At this level of management, upward adjustments are not necessary.

[b] Values estimated from "Grazing Management of Irrigated Grass Pastures" (G81-563). Four-way grass mix is comprised of smooth brome, meadow brome, Garrison creeping foxtail and orchardgrass.

[c] Values adapted from "Forage Balance Sheets for Nebraska" (EC 72-189).

COLOR KEY | GOOD | FAIR | POOR | BAD

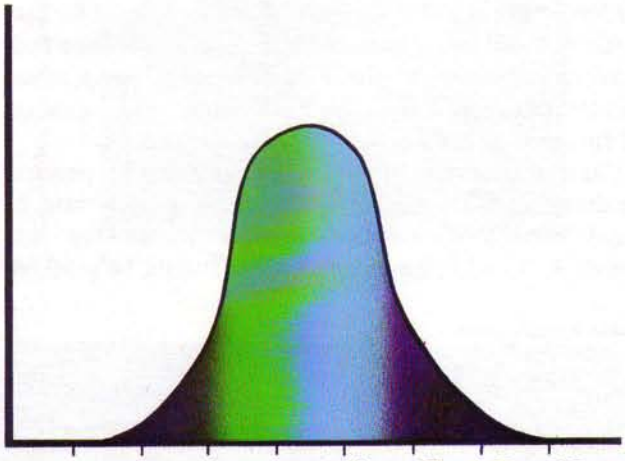
Figure 4a. Switchgrass



Mar Apr May Jun Jul Aug Sep Oct Nov

Switchgrass must be grazed prior to heading for good animal acceptance and performance. Grazing early in the season to reduce heading will provide fair quality regrowth and improved livestock gains.

Figure 4b. Big Bluestem



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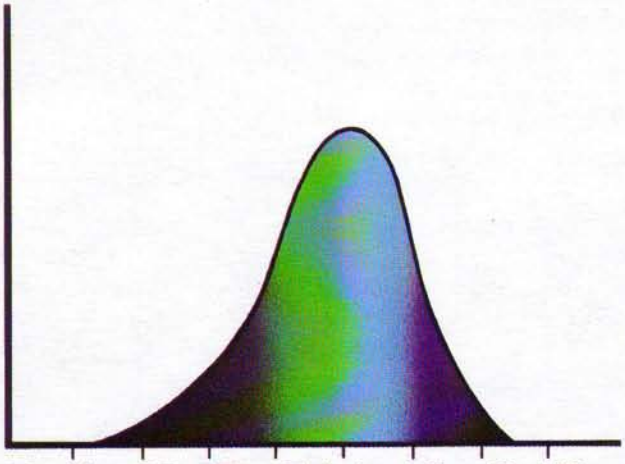
Big bluestem is more palatable at later stages of maturity than other warm-season grasses. However, when grazed early in the season, its regrowth is more productive and leafier.

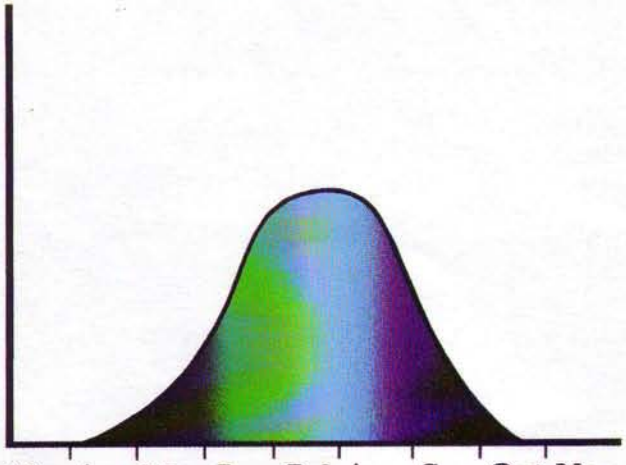
Figure 4c. Indiangrass



Mar Apr May Jun Jul Aug Sep Oct Nov

Indiangrass heads later and retains feed value on ungrazed forage until mid-to late-summer better than switchgrass or big bluestem. Regrowth is often slow unless grazed early.

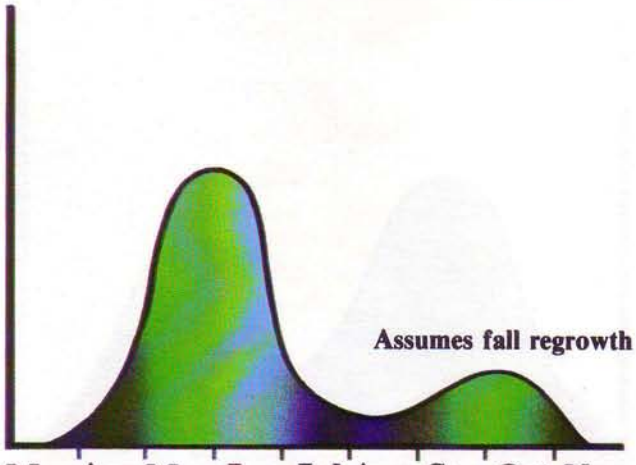
Figure 4d. Native Warm-Season Range



Mar Apr May Jun Jul Aug Sep Oct Nov

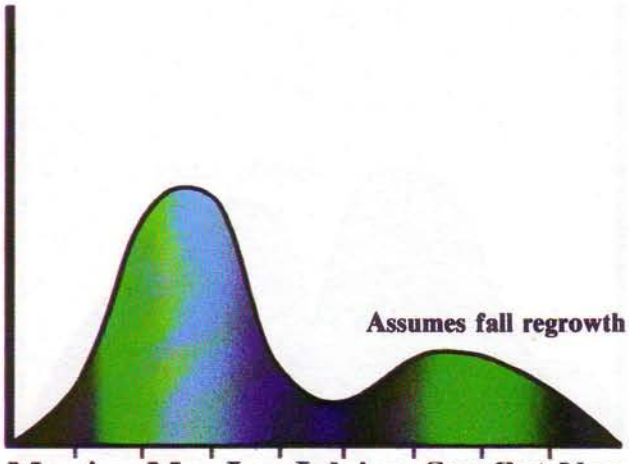
Species composition will cause growth distribution and forage quality of warm-season range to vary.

Figure 4e. Smooth Brome, Kentucky Bluegrass



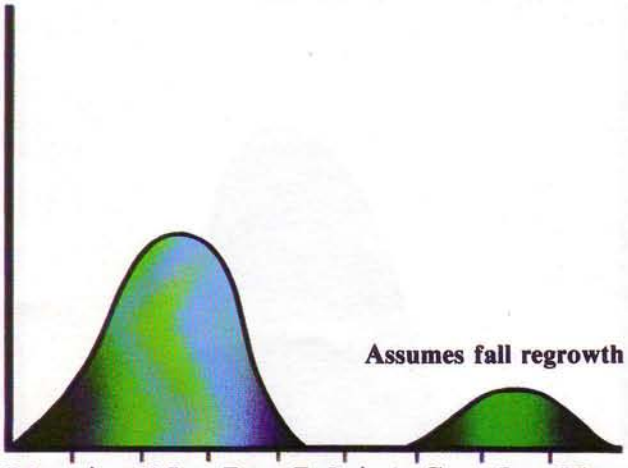
Close grazing of cool-season grasses in spring results in a small amount of fair quality regrowth during summer. Fall regrowth depends on rainfall and is best used if a period of non-use precedes grazing.

Figure 4f. Tall Fescue



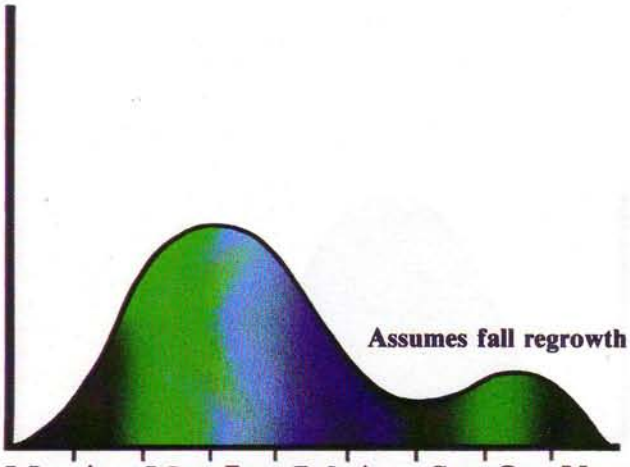
Close grazing in spring results in some fair quality regrowth during summer. Fall regrowth depends on rainfall. Fall quality of tall fescue is very good and will remain good until frozen. Endophyte-free tall fescue will provide higher quality spring and summer forage than will endophyte-infected fescue.

Figure 4g. Crested Wheatgrass



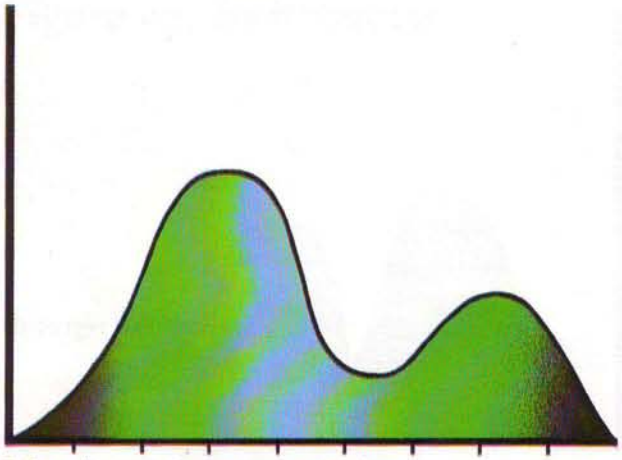
Crested wheatgrass does not grow well during summer. Summer forage quality is poor.

Figure 4h. Native Cool-Season Range



Cool-season range does not grow well during summer. Summer forage quality is poor.

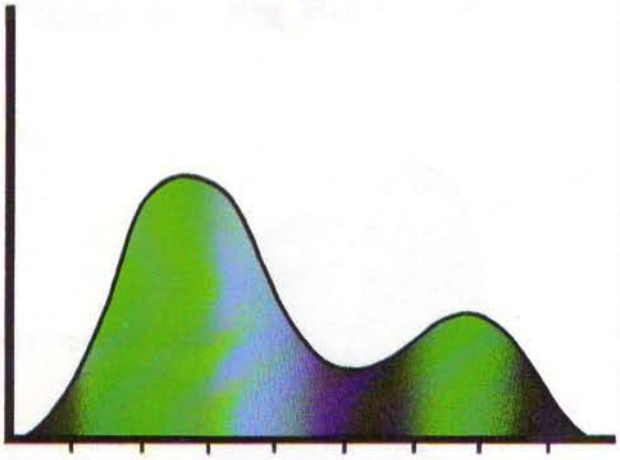
Figure 4i. Irrigated Cool-Season Grass



Mar Apr May Jun Jul Aug Sep Oct Nov

Irrigated cool-season grass will not grow rapidly in summer but forage quality will be fair. If irrigation water is not supplied during summer, fall regrowth will still be plentiful and good quality if irrigating begins one month before grazing.

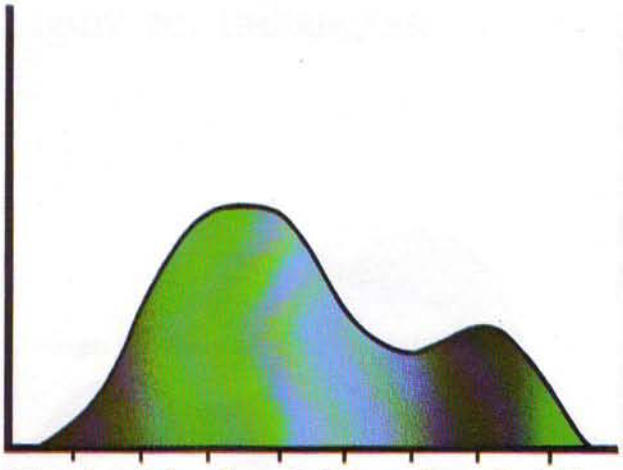
Figure 4j. Orchardgrass, Creeping Foxtail



Mar Apr May Jun Jul Aug Sep Oct Nov

Close grazing in spring results in a small amount of fair quality regrowth during summer. Fall regrowth depends on rainfall and is best used if a period of non-use precedes grazing. Orchardgrass and creeping foxtail produce more summer growth than other cool-season grasses when moisture is available.

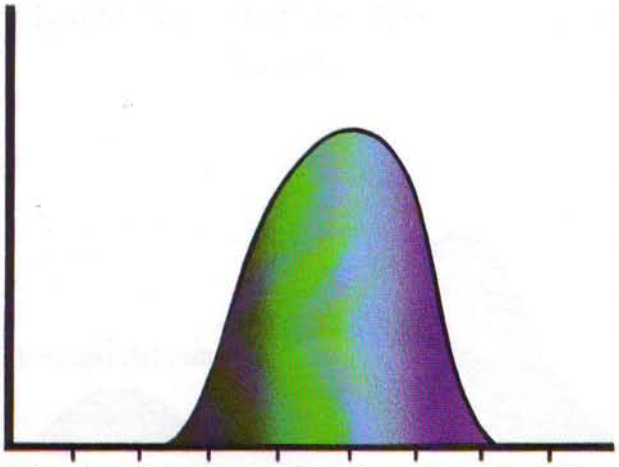
Figure 4k. Grass and Legume



Mar Apr May Jun Jul Aug Sep Oct Nov

Rotational grazing is necessary to maintain desirable legume-grass stands. Most grass-clover or alfalfa mixtures will be mostly legume during summer regrowth and will increase the hazard of bloat.

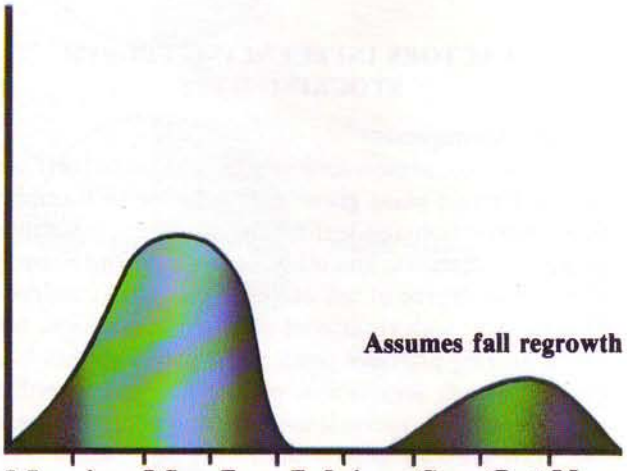
Figure 4l. Sudangrass



Mar Apr May Jun Jul Aug Sep Oct Nov

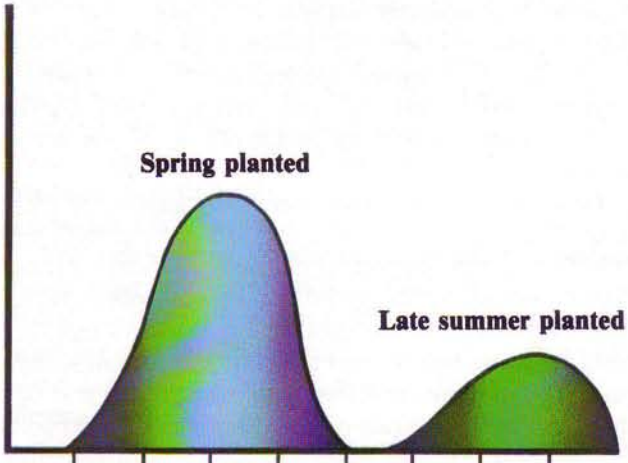
Avoid grazing sudangrass until it is 15-20 inches tall to reduce prussic acid potential. Sudangrass will become stemmy and poor quality unless flash grazed or rotationaly grazed. When grazed rotationaly more uniform forage distribution will occur and forage quality will remain higher.

Figure 4m. Winter Small Grains for Graze-out



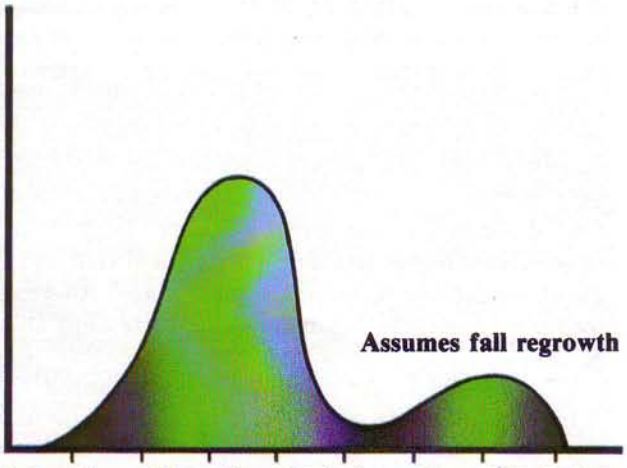
Early planting and rainfall are necessary for fall grazing of small grains. Spring growth will be stunted by heavy fall grazing. Quality declines very rapidly when seedheads develop.

Figure 4n. Oats for Graze-out



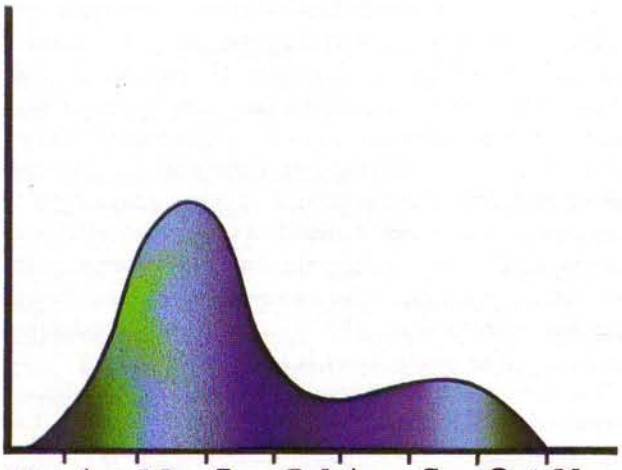
Early planting and rainfall are necessary for fall grazing of small grains. Quality declines very rapidly when seedheads develop.

Figure 4o. Tall, Intermediate and Western Wheatgrass



Close grazing of cool-season grasses in spring results in a small amount of fair quality regrowth during summer. Fall regrowth depends on rainfall and is best used if a period of non-use precedes grazing.

Figure 4p. Reed Canarygrass



Close grazing of cool-season grasses in spring results in a small amount of fair quality regrowth during summer. Fall regrowth depends on rainfall and is best used if a period of non-use precedes grazing. Low alkaloid, high palatability varieties of reed canary grass will provide higher quality spring forage than will native or higher alkaloid containing varieties.

early enough to efficiently use forage before it becomes mature, unless stockpiling of pasture is desired and lower quality is acceptable. Generally, late in the season, do not graze closely so plants can accumulate carbohydrate reserves.

Figures 4a-p illustrate three components of forage production—growth rate, distribution of forage growth, and seasonal changes in forage quality. For warm-season grasses, the figures represent ungrazed plants. For cool-season species, the figures represent ungrazed spring growth while fall regrowth typifies growth following grazing or harvesting of the spring growth.

These generalized patterns are only guides for planning. The basic pattern of a forage plant's growth and quality does not change; its physiological and morphological characteristics are genetically controlled. Nonetheless, environment and grazing management can alter plant response in a limited amount. For example, temperature and moisture differences from year to year can shift the timing and rate of growth of any forage plant. Grazing also alters the pattern of growth. Grazing often lowers the peak growth rate due to added stress on the plant but regrowth can be stimulated so moderate growth rates will continue longer and forage quality will decline at a slower rate.

The growth curve for ungrazed switchgrass illustrates the planning information provided (Figure 4a). The height of the curve at any date represents how fast the forage is growing relative to other times of the year. Early in the growing season, growth rate is slow and the percent of total forage production is small (April 1-May 1). Growth rate increases rapidly as environmental conditions improve. The longer the plant can be maintained in a rapid growth phase, the greater the total production will be. Most plants should not be grazed until reaching approximately 50 percent of their maximum growth rate (about May 25 for switchgrass). Before this time there is not enough forage accumulated to allow production to stay ahead of livestock demand. As environmental conditions become less favorable, the plant forms stems and seeds (about July 1 for switchgrass) and the growth rate decreases rapidly. The percent of total production produced after plants head is relatively small.

The area under the curve represents the total forage produced by the plant during the growing season. Use this to estimate the seasonal distribution of forage production. In the switchgrass example, nearly 70 percent of the total production is expected to occur by July 1 (Figure 4a). Before July 1, forage growth is relatively rapid and forage quality is high. After seedheads develop, growth rate declines rapidly. Since new growth does not occur as fast as existing forage matures, forage quality declines rapidly.

In the switchgrass example (Figure 4a), do not graze before May 25 and complete most grazing by July 1. If regrowth is stimulated, grazing may remain good for 2 or 3 more weeks or regrowth can be grazed later in the season. This grazing strategy will use most of the forage when it is of highest quality and maintain the plant in an active growth phase. Avoid late-season grazing. Again, these curves are only general guidelines for grazing management and should be modified for specific situations.

FACTORS INFLUENCING PROPER STOCKING RATE

Grazing Management

Continuous, season-long grazing can be an inefficient way to harvest plant growth. Losses due to trampling, plant maturation and leaf death, wastage, consumption by insects, diseases, and other herbivores, and improper season and degree of use are all higher with continuous grazing than with rotational grazing. In addition, rotational grazing provides times when plants are not being grazed in each area. Thus, plant vigor and growth remain the same or increase compared to continuous grazing, even when a greater proportion of the forage is consumed by livestock.

A simple rotation involves two or more separate pastures that are each grazed only once during the growing season. (See NebGuide G75-218, Planned Rangeland Grazing Systems). Such systems can provide 20 percent higher grazing capacity than continuous grazing. More intensive short duration or time-controlled grazing systems that involve numerous areas that are grazed several times each season might allow up to 30-50 percent higher stocking rates than continuous grazing. These are common on irrigated or dryland cultivated pasture; however, they are not generally recommended for native range. These intensive rotation grazing programs improve livestock distribution, reduce waste, allow longer periods of no grazing, and maintain plants in a more nutritious vegetative growth stage for longer periods of time. However, as grazing intensity increases so does the risk of weakening the forage resource. High stocking rates require higher levels of management skill and frequent monitoring to maintain plant vigor. Alternative feed sources and/or flexibility in herd size must always be available to adjust stocking rates whenever forage availability and forage demand are not balanced.

In the example on estimating forage yield, the forage yield was 1,360 pounds per acre. For continuous, season-long grazing, 50 percent of the yield should remain on the plant at the end of the season to maintain plant vigor and health. About 25 percent is lost due to trampling, wastage, insects, herbivores, etc. Thus, only 25 percent (340 pounds per acre in the example) is available for livestock use (Figure 3,5). For this example, the stocking rate would be .5 AUMs per acre (340 pounds per acre divided by 680 pounds per AUM).

Simple pasture rotations allow plants time to grow without grazing stress during much of the growing

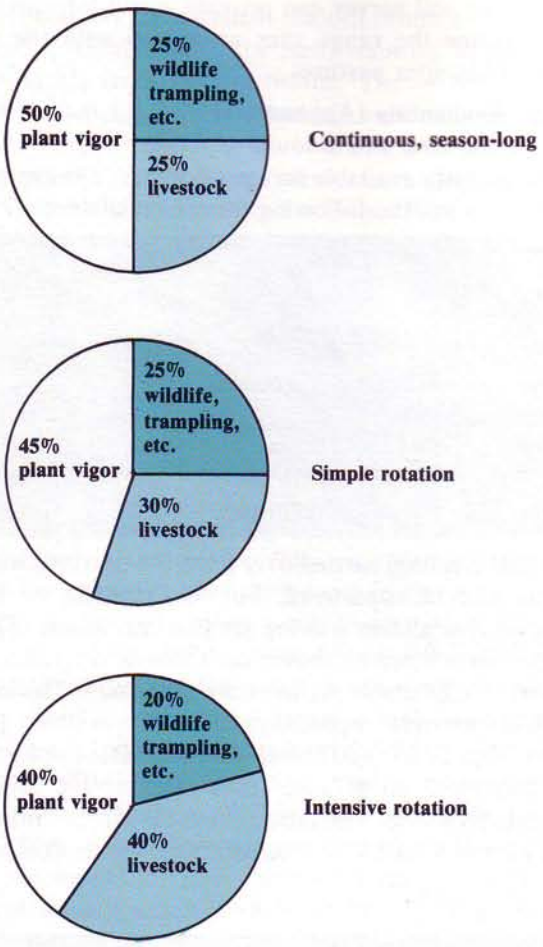


Figure 5. Influence of grazing management on the allocation of end-of-season forage.

season. Plant vigor and growth remains high even when more of the forage is consumed by livestock and less remains on the plant. About 30 percent of the forage yield can be grazed in simple rotations and only 45 percent needs to remain on the plant. The example can provide 408 pounds per acre (1,360 x .3) for a stocking rate of .6 AUMs per acre (408 ÷ 680).

Intensive rotations allow plants even more time to grow without grazing stress than do simple rotations. In addition, losses due to trampling, wastage, leaf death, improper season of use, etc., are reduced to about 20 percent. Livestock can consume 40 percent of the forage and only 40 percent needs to remain on the plant. For the example, 544 pounds per acre (1,360 x .4) are available for grazing in intensive rotations, which is a stocking rate of .8 AUMs per acre (544 ÷ 680).

Weather

Suggested initial stocking rate assumes 'normal' weather, good plant vigor, uniform grazing patterns, and level consumption. These assumptions are often incorrect so stocking rate must be changed to fit each situation. Weather variation most frequently forces stocking rate adjustments. Drought, floods, late spring or early fall frost, hail, or very cool or very hot temperatures may lower forage production or delay growth. Rapid forage growth and high yields are often encouraged by abundant soil moisture, timely rains, warm springs, and moderate summer temperatures.

Plant Vigor

Prior over-grazing or adverse weather conditions may reduce desirable plant vigor. Indicators of good plant vigor are abundant new tillers or rhizomes, rapid regrowth (in spring, after grazing, or following the breaking of a drought), and an appropriate amount of plant material remaining unused at the end of the season. When vigor is low, reduced stocking rate can encourage renewal of plant health.

Livestock Distribution

Uniform grazing should be encouraged throughout the grazing area (see NebGuide G80-504, Proper Livestock Grazing Distribution). When this is not possible, stocking rate should be reduced proportionately to the areas avoided or inaccessible to the livestock.

Forage Intake

Forage intake changes very little for a group of livestock during a grazing season (except when large weight changes occur) so stocking rate adjustments are not needed. However, environmental stress, forage quality, and previous nutrition of the animal may influence level of forage consumption by livestock. Insects, rodents, game animals, and other herbivores also consume forage and may alter the amount available to livestock at certain times.

HAY AND SILAGE

Hay is converted to an AUM basis assuming approximately 2.5 AUM per ton. Silage varies in moisture content so it must be converted to a dry matter basis before its AUM value can be determined. Table 5 lists the value for silage at different moistures.

Normal corn silage will have a moisture percent between 60 and 70 percent. Dry corn silage may be as low as 50-60 percent moisture. Direct-cut grass and legume silage will be about 70-75 percent moisture while wilted silage will probably range between 60-70 percent moisture. Low moisture silage is generally stored at 35-60 percent moisture.

Table 5. AUM value of silage stored at different moisture levels.

Silage moisture %	*AUM/T of silage*
80	0.60
75	0.75
70	0.90
65	1.00
60	1.20
55	1.30
50	1.50
45	1.60
40	1.80
35	1.90

Hay and silage sometimes are limit-fed to avoid excessive weight gains (e.g., dry cows) or they are fed as supplements. When this management need occurs, the forage demand (intake given free access) may exceed forage required and feeding should be based on a balanced nutrient ration rather than intake demand.

SUMMARY

This initial recommended stocking rate guide is for planning. It estimates initial stocking rates and suggests adjustments based on local conditions. Managers must be aware of all the environmental and management factors that can affect the proper stocking rate. They must recognize when to reduce stocking rates or when forage is available to increase stocking rates. Use this guide to begin to develop initial stocking rates and to modify grazing programs to local conditions.

FORAGE PLANNING GUIDE EXAMPLE

An example farm-ranch will be used to illustrate forage planning and the appropriate use of information in this planning guide. This farm-ranch is located in eastern Nebraska (Vegetative Zone IV, Figure 2). The predominant soil in the area is silty. In this example, it will be assumed that the soil type is constant, but it is common to have several soil types on a farm or ranch. The county soil survey can provide useful information to determine the range sites associated with the soil types within your pastures.

Forage Availability (Appendix 1)

I. *Define kind and amount of forage*

First identify available forage resources. The example farm-ranch has the following forages available:

alfalfa (5 T/acre) ..... 60 acres
alfalfa aftermath (1 AUM/acre) ..... 60 acres
corn stalks ..... 50 acres
smooth brome (4 AUM/acre) ..... 100 acres
native range (silty, 60-65 percent range condition) ..... 900 acres
switchgrass (silty, 3 AUM/acre) ..... 75 acres
big bluestem (silty, 5 AUM/acre) ..... 125 acres
silage (18 T/acre, 65 percent moisture) ..... 12 acres

Hay that has been carried over from the previous winter should also be considered. For this example we have assumed that all hay was fed the previous winter. These forages were listed as shown on Table 6.

Next, the available AUMs were calculated. The alfalfa will provide approximately 750 AUMs [(2.5 AUM/T)(5 T/acre)(60 acres) = 750 AUMs]. Corn stalks will provide 2 AUM/acre for a total of 100 AUMs. Smooth brome in Vegetative Zone IV can provide between 2 and 6 AUM/acre on a silty range site (Table 3).

Table 6. Forage availability example.

Kind of Forage	AUM/ acre	Acres	AUMs	Month											
				J	F	M	A	M	J	J	A	S	O	N	D
Alfalfa	12.5	60	750	150	150	150	150							75	75
Alfalfa aftermath	1.0	60	60										60		
Corn stalks	2.0	50	100											50	50
Smooth brome	4.0	100	400					160	80				160		
Native range	.75	900	675						95	190	190	190			
Switch-grass	3.0	25	75						50	25					
Big bluestem	5.0	25	125							25	50	50			
Silage	18	12	216	36	36	36	36							36	36
Excess hay	0	0	0												
Total		1372	2401	///// /////	///// /////	///// /////	///// /////	///// /////	///// /////	///// /////	///// /////	///// /////	///// /////	///// /////	///// /////
Total AUMs Allocated				186	186	186	186	160	225	240	240	240	220	161	161
Total AUMs Required (From Table 7)				141	141	141	169	169	169	196	196	196	141	141	141
Total AUMs Excess/deficiency				45	45	45	17	-9	56	44	44	44	79	20	20

This producer has excellent smooth brome that has produced 4 AUM/acre in the past, resulting in a total of 400 AUMs from smooth brome. The switchgrass pasture yielded 3 AUM/acre and big bluestem produced 5 AUM/acre.

Available AUMs from native range were calculated by first estimating range condition. Range condition estimates production based on the plant species that are present. The Range Judging Handbook for Nebraska (EC84-109) describes how to calculate range condition. Generally, there will be more than one range condition class within a range site and often more than one range site within a pasture. In this example, assume that the average range condition for the entire 900 acres (silty range site) is between 60 and 65 percent. Look-up the AUM/acre value for this range site when the range condition is 100 percent (Table 2). The value listed is 1.0 AUM/acre. Now adjust this recommended stocking rate for the calculated range condition by using the stocking rate adjustment chart (Figure 4). Find 60-65 percent range condition on the bottom line and follow it up until it intersects the curve. When range condition is between 60 and 65 percent, you intersect the curve at approximately the .75 adjustment factor for initial stocking rate. Thus, initial carrying capacity for this pasture is .75 AUM/acre [(.75 adjustment factor)(1.0 AUM/acre at 100 percent range condition)]. The total AUMs available from the native range is 675 [(.75 AUM/acre)(900 acres) = 675 AUMs]. In this example the range will be grazed continuously so no adjustment for grazing management is needed.

Convert silage to an AUM basis (Table 5). The AUM value for silage at 65 percent moisture is 1.0 AUM/T. If 18 T/acre is harvested from 12 acres, 216 tons of silage will be available. This will provide approximately 216 AUMs [(1.0 AUM/T of silage)(216 T of silage)].

II. *Determine when to graze or feed available forage*

Forages can generally be allocated over the year based on characteristics of the forage, desired use (feed or graze), and the livestock operation. In this example, the producer has a cow-calf-yearling operation raising replacements. Consequently, winter feed must be provided. Alfalfa is an excellent hay and often is fed from November to April. Some producers feed hay through May, but in this example smooth brome provides May pasture. Alfalfa aftermath can be used in October. Corn stalks are best used in November and December, hopefully before any substantial snow cover. Corn silage is fed and can be used at anytime; however, it is commonly fed to growing animals in the winter months (November-April/May).

Planning grazing is more challenging. Profitable animal performance is obtained only when pastures are managed for optimum quantity and quality of forage as well as stand persistence. Use the growth curves to identify the most appropriate times to graze (Figures 4a-p). For most pastures optimum forage quantity and quality occurs between the time that growth becomes rapid until the growth rate begins to decline. Delaying initial grazing until after the peak rate will not dramatically increase quantity, but it will result in a much lower quality.

The growth curves show that smooth brome is best used in spring (May-June 15) and fall (September-October). Switchgrass should be grazed in June and July while big bluestem could be grazed from July 15 through September. Native range can be grazed from June 15 through September. Allocate forages according to the kind of livestock operation and their forage needs. A common way to use the forages available in this example is:

alfalfa	hay for all classes of livestock
alfalfa aftermath	weaned calves
corn stalks	gestating cows
silage	replacement heifers and yearlings
smooth brome	all classes of livestock
native range	cow-calf pairs (can tolerate some loss in forage quality late in the season if ownership on the calves is retained)
switchgrass	yearlings and heifers
big bluestem	yearlings and heifers

III. *Allocate AUMs by month*

Begin balancing the forage supply by dividing the total number of AUMs available among those months in which the forage is to be used. The example in Table 6 for smooth brome, native range, switchgrass, and big bluestem uses this approach. Knowing the kind of livestock operation will allow a more refined approach as suggested by the alfalfa hay example. In this case, it is apparent that some hay will be fed to growing animals in the fall; consequently some was allotted. The last step in completing Table 6 is to sum the available AUMs by month and by year.

Forage Demand (Appendix 2)

I. *Livestock inventory*

A complete livestock inventory by month was developed for the farm-ranch (Table 7). In this example the producer has a 100-cow herd calving in mid-March with a 90 percent calving rate. Cattle are culled and weaned October 1 at a 15 percent cull rate. Replacement heifers (15 for this example) are raised to calve as two-year-olds and join the cow herd. The herd has a bull:cow ratio of 1:20. The replacement heifers are artificially inseminated. Of 5 bulls in the herd, two are young, and three are mature.

The number of livestock for each class of livestock was entered on the top line in Table 7. Each class of livestock must be properly catagorized before assigning the

Table 7. Forage demand example.

Kind/Class of Livestock	Animal Unit Value	#/ AUs	Month											
			J	F	M	A	M	J	J	A	S	O	N	D
Mature cow (non-lactating)	0.9	#	85	85	85	Cows calved						85	85	85
		AUs	76	76	76							76	76	76
Mature cow (lactating)	1.0	#				100	100	100	100	100	100	Cows culled		
		AUs				100	100	100	100	100	100			
Replacement bred heifers (18-24 months)	0.8	#	15	15	15	Replacement heifers join cow herd						15	15	15
		AUs	12	12	12							12	12	12
Replacement yearling heifers (12-17 months)	0.7	#				15	15	15	15	15	15			
		AUs				10	10	10	10	10	10			
Replacement heifer calves (6-12 months)	0.5	#	15	15	15	Replacement heifers bred						15	15	15
		AUs	8	8	8							8	8	8
Calves (3-4 months through weaning)	0.3	#				90	90	90	90	90	90			
		AUs				—	—	—	27	27	27			
Weaned steer/heifer calves (6-12 months)	0.5	#	75	75	75							75	75	75
		AUs	38	38	38							38	38	38
Yearling steers/heifers (12-17 months)	0.7	#				75	75	75	75	75	75	Yearlings sold		
		AUs				52	52	52	52	52	52			
Young bulls (12-24 months)	1.2	#	2	2	2	2	2	2	2	2	2	2	2	2
		AUs	2	2	2	2	2	2	2	2	2	2	2	2
Bulls (mature, 2-5 years)	1.5	#	3	3	3	3	3	3	3	3	3	3	3	3
		AUs	5	5	5	5	5	5	5	5	5	5	5	5
Total		#	195	195	195	285	285	285	285	285	285	195	195	195
		AUs	141	141	141	169	169	169	196	196	196	141	141	141

AU value (Table 1). For example the cows should be listed as non-lactating for part of the year and lactating for the remainder of the year.

II. *Calculate AU value (forage demand)*

The total number of AUs by month for each class of livestock was determined by multiplying the AU value listed for each class of livestock by the number of livestock in that category (Table 7). Thus, 85 non-lactating cows equals 76 AUs [(85 non-lactating cows)(.9 AU/non-lactating cow) = 76 AUs]. By calculating these AUs on a monthly basis (month = 1), then the AUM demand for each month is determined automatically [(AU)(month) = AUM]. In this example (Table 7), 85 nonlactating cows in January will require 76 AUMs of forage.

III. *Balance forage availability and demand*

The total AUM values by month from Table 7 were entered in the 'AUM Required' row on Table 6. The difference between 'required' and 'available' identifies forage excesses or shortages by month. Plan for a certain amount of excess each month (10-20 percent of the AUMs required) to insure against a harsh winter, poor hay crop, drought, hail, early freeze, late frost, or any other environmental or management impact on forage production. In this example (Table 6), there is at least 10 percent excess of the forage in all months except May

[e.g., April: (186 AUMs available -169 AUMS required)/169 AUMs required = 10 percent].

May appears to have a slight forage shortage. Although livestock numbers could be reduced to solve this problem, first evaluate other potential solutions that involve distribution or production levels of available forage. More smooth brome might be allocated in May while reducing that for June, since June has a considerable excess of forage. Hay or silage could be fed to some animals into May to reduce the smooth brome requirement. Smooth brome pastures might increase in production with fertilizer or a rotation grazing program.

In subsequent years after forage production and management reach the desired level for the farm-ranch, balance variation in forage production using the livestock inventory. For example, if winter hay supplies are about right while summer months have a large excess of available forage, lease out some summer pasture or buy yearlings to graze. If summer grazing supply is low, sell all heifer calves except replacements. To balance the forage availability and forage demand, consider all the management flexibility available from both forage and livestock resources.

This example developed the 'Forage Availability' (Appendix 1) before establishing the 'Forage Demand' (Appendix 2), since livestock inventory was easier for this producer to change than forage inventory. However, the livestock inventory can be developed first to guide current forage use and define new forage needs. While livestock operations depend on the current forage base and the potential to modify that base, efficient use of existing or future forage resources depends on the flexible livestock management. Balancing forage availability to forage demand must be a part of all planning stages. Changes in the forage and livestock programs are not independent management decisions: each depends upon the other.

Appendix 1. Forage availability.

Kind of Forage	AUM/ acre	Acres	AUMs	Month											
				J	F	M	A	M	J	J	A	S	O	N	D
Total				///// /////	///// /////	///// /////	///// /////	///// /////	///// /////	///// /////	///// /////	///// /////	///// /////	///// /////	///// /////
Total AUMs Allocated															
Total AUMs Required															
Total AUMs Excess/deficiency															

Appendix 2. Forage demand.

Kind/Class of Livestock	Animal Unit Value	#/ AUs	Month											
			J	F	M	A	M	J	J	A	S	O	N	D
Mature cow (non-lactating)	0.9	#												
		AUs												
Mature cow (lactating)	1.0	#												
		AUs												
Replacement bred heifers (18-24 months)	0.8	#												
		AUs												
Replacement yearling heifers (12-17 months)	0.7	#												
		AUs												
Replacement heifer calves (6-12 months)	0.5	#												
		AUs												
Calves (3-4 months through weaning)	0.3	#												
		AUs												
Weaned steer/heifer calves (6-12 months)	0.5	#												
		AUs												
Yearling steers/heifers (12-17 months)	0.7	#												
		AUs												
Young bulls (12-24 months)	1.2	#												
		AUs												
Bulls (mature, 2-5 years)	1.5	#												
		AUs												
Total		#												
		AUs												

Assistance from the

is greatly appreciated.