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RangeDetect Series

Stocking Rate: The Key Grazing Management Decision

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Without question, stocking rate is the most important grazing management decision a rancher makes. Stocking rate is the amount of land allotted to each animal for the entire grazeable portion of the year. Stock density is the number of acres allotted to each animal at a specific point in time. Carrying capacity, on the other hand, is the maximum long-term stocking rate that can be sustained without detrimental effects on the land resource. A number of factors must be considered when establishing a stocking rate. These factors include animal species, size and physiological stage, size of the pasture or ranch, and number of grazeable acres. Ranches differ in annual rainfall, forage production, forage species, brush cover, topography, water distribution, and kind of livestock. All of these factors affect stocking rates.

When cattle have a choice, annual diets consist of 80 percent or more grass and usually no more than 10 percent browse (leaves and twigs from brush). Cattle make limited use of slopes greater than 10 percent or areas more than 2 miles from water. Therefore, when establishing a stocking rate for cattle, very brushy areas, steep areas, and areas too far from water must be excluded to determine the number of grazeable acres.

There are two perspectives to stocking rate. One is the land resource. The second is animal performance. Because of animal forage preferences, it is possible to be properly stocked from a resource conservation perspective and over-stocked in terms of animal performance.

Forage Production Considerations

Rainfall and Forage Production

For most of Texas, rainfall is the most important determinant of forage production. If rainfall is equal across various sites, then the soils and forage species combinations of a site are the most important factors in a site's forage production potential.

Resource managers tend to look at average rainfall as a benchmark. However, relying on average rainfall amounts is risky because rainfall across most of Texas is highly variable from year to year (as the recent drought reminds us). The farther west in the state, the more variable annual rainfall becomes. Annual rainfall totals and averages can be deceptive. One huge rain over a short period of time can increase total rainfall for the year with minimal effect on soil moisture and forage production. In Figure 1, total annual rainfall, average annual rainfall, and drought level (drought is considered to be 75 percent of average annual rainfall) are illustrated for Dimmit County, Texas from 1931 to 1994. For most years in this example, rainfall is either above or below average. In fact, for at least half the years, annual rainfall was below average. Furthermore, in this example there is only about an 11 percent chance that total rainfall within any one year will be within 1 inch of the long-term annual average. So, if a rancher bases stocking rate on average annual rainfall, the range will be overstocked at least half the time.

A major goal in grazing management must be to leave enough forage in a pasture to protect the soil and maintain plant vigor (Table 1).

Table 1. Suggested forage residue levels for maintaining soil stability and plant vigor.

Vegetation type	Pounds/acre	Stubble height (inches)
Tallgrass	1200-1500	12-14
Midgrass	750-1100	6-8
Shortgrass	300-500	2-3

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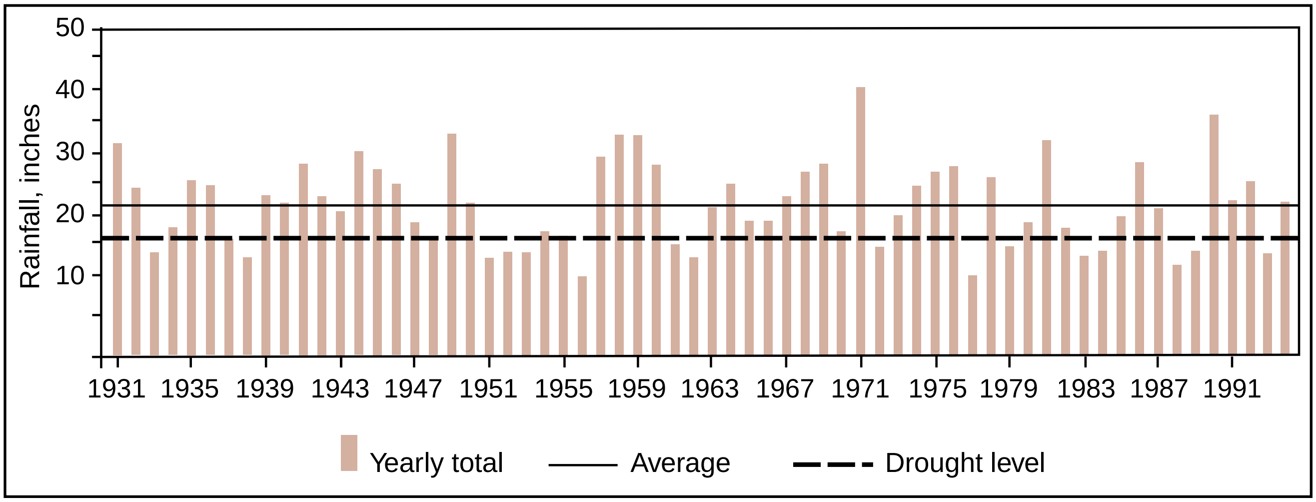

Figure 1. In this example of rainfall variability in Dimmit County, Texas, total annual rainfall for at least 50 percent of the years was below the average annual rainfall. In addition, there is only an 11 percent chance that annual rainfall for any one year will be within 1 inch of the annual average.

Forage residues affect future forage production. Figure 2 illustrates relationships among forage residue, rainfall, and forage production. In this example, leaving 500 pounds of residue produced twice as much forage as leaving only 100 pounds. Furthermore, leaving 1500 pounds of residue produced as much forage as 500 pounds of residue even though rainfall was far less. Areas with greater residue are more efficient at capturing and retaining rainfall.

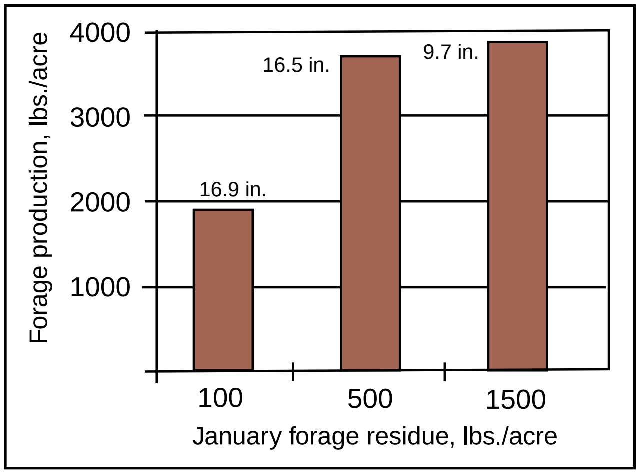

Figure 2. Effect of forage residue on forage production. Numbers above bars indicate rainfall.

Conduct forage inventories in late June or early July, October and March to estimate available forage and make stocking adjustments. For cattlemen, grass is the primary production goal and it must be managed properly to sustain long-term productivity. Too often a blanket stocking rate is used for a county or region when the stocking rate should be tailored to each grazing management unit, whether a pasture or an entire ranch.

What Does a Given Stocking Rate Mean?

The old rule of thumb "take half, leave half" is well publicized, but may not be well understood. This rule applies to average annual forage production. It does not mean that half the forage can be allotted to grazing animals. Part of what is taken will go to the animals, but part will disappear through trampling, decay and insect damage. This disappearance is usually about 25 percent of the average annual production. Therefore, only 25 percent is left for the grazing animal.

As an example, let's assume that a rancher is using a stocking rate of 20 acres per animal unit per year (AUY).

An animal unit consumes 26 pounds of forage per day, or 9,490 pounds per year.

(26 x 365 = 9,490)

The rancher has allotted 20 acres to produce the 9,490 pounds of forage needed per AUY. Therefore, each acre must produce 475 pounds of forage yearly to support grazing.

(9,490 ÷ 20 = 475)

If 475 pounds represents 25 percent of the total forage needed (because 25 percent of the total will be lost to trampling, etc., and 50 percent will be left as residue), then the total forage production will need to be 1,900 pounds per acre.

(475 x 4 = 1,900)

In this example, 950 pounds of forage per acre would be left to maintain soil stability and plant vigor.

Range Sites

Range sites are areas with distinctive combinations of soils, land features, and natural vegetation. Range sites differ in the kinds and amounts of forage they produce and in their carrying capacity. The comparison in Table 2 illustrates this point.

Table 2. Differences in carrying capacity between two range sites, both in excellent condition.

Range site	Favorable year, acres/animal unit	Unfavorable year, acres/animal unit
Clayey bottomland	8	13
Gravelly ridge	13	25

Range Condition

Range condition is a numerical score comparing current plant composition with pristine (believed to exist before the occupation of European man) plant composition. Table 3 compares carrying capacities for the various range condition classes of one range site.

Table 3. Carrying capacities for different range condition classes for one range site.

Range condition	Acres/animal unit year
Excellent	10-15
Good	16-20
Fair	21-28
Poor	29-40

Livestock Considerations

Not Every Cow is An Animal Unit

Resource management professionals are sometimes asked to recommend a stocking rate for a particular area or particular kind of grazing livestock. These recommendations are typically based on one cow or animal unit per "x" acres. However, not every cow is an animal unit. In fact, an animal unit, like most units of measure, is arbitrary. The definition of an animal unit has continually changed. Currently, the most widely accepted definition of an animal unit is a mature, 1,000-pound cow and her calf, representing an average daily dry matter forage intake of 26 pounds. This average daily forage intake can also be expressed as a percentage (2.6 percent) of the cow's body weight. Stocking rate recommendations should be based more on potential forage intake than on numbers of animals. If you know the potential forage intake of a particular species of livestock, you can determine the total forage production needed to leave an adequate amount of residue.

Cow Size

The mature size of beef cows has steadily increased since the 1950s. Today's "average" beef cow probably weighs 1,150 to 1,200 pounds. Therefore, these cows are not equivalent to one animal unit. Different size cows require different stocking rates.

For example, if the estimated stocking rate for a 1,000-pound cow is 20 acres, the **estimated stocking rate for the 1,150-pound cow** (assuming both have the same forage intake rate of 2.6 percent of body weight) is found as follows:

> 1,150 pounds x 0.026 = 30 pounds forage intake per day ÷ 26 pounds forage per animal unit = 1.15 animal units per cow

Therefore, 1.15 animal units per cow x 20 acres per animal unit = **23 acres per 1,150-pound cow.**

Cow Body Condition

Estimating forage intake from a cow's weight can cause some degree of error if the cow's body condition score is not considered. Weight per body condition score (about 8 percent of weight at a body condition score of 5) varies from about 72 pounds for a 900-pound cow to about 104 pounds for a 1,300-pound cow. For example, a cow weighing 1,000 pounds at a 5 body condition score would weigh about 840 pounds at a 3 body condition score or 1,160 pounds at a 7 body condition score. The fact that this cow is lighter or heavier because of body fat content does not mean she will consume less or more forage than when she weighs 1,000 pounds. By using a condition score 5 weight for cattle, these calculations can be standardized, and forage intake can be estimated relative to intake potential as animal size (gut capacity) increases.

Cow Productivity

Another factor that creates differences in stocking rate estimates is production level. Cows that produce heavier calves usually produce more milk, and therefore, eat more forage. These cows need more acres to satisfy their forage demand and still leave the proper amount of forage residue. Average annual forage intake rates of 2.6, 3.0 or 3.5 percent can be achieved by beef cows with low, medium or high milk production levels, respectively. Cows are certainly capable of eating even more. For example, one dairy cow was documented to have a dry matter intake rate of 7 percent of body weight.

If the estimated stocking rate for a low-milking, 1,000-pound cow is 20 acres, a high-milking, 1,000-pound cow might need 27 acres. If the high-milking cow also weighs 1,150 pounds, the estimated stocking rate would be 31 acres per cow.

Setting Stocking Rates for Different Kinds of Livestock

When determining stocking rates for sheep and goats, range managers usually use the rule of thumb that five sheep or six goats equal one animal unit, implying that this number of sheep or goats consumes the same amount of forage as a 1,000-pound cow and her calf consuming forage at the rate of 2.6 percent of the cow's weight. By using body weights and appropriate forage intake rates for each species, more specific stocking rates can be determined. For sheep, a typical forage intake rate is 3.0 to 3.5 percent of body weight. Goats typically have a forage intake rate of 4.0 to 4.5 percent of body weight. Again, highly productive animals would have intake rates at the high end of the range. To illustrate this approach, calculate the animal unit equivalent for Boer goats weighing 130 pounds and having a forage intake rate of 4 percent.

Estimated forage consumption for these goats is 5.2 pounds of dry forage per day.

(130 pounds x 0.04 =5.2 pounds)

This means that it would take about five of these goats to equal one animal unit. (26 pounds per animal unit ÷ 5.2 pounds per goat = 5 goats per animal unit)

Determining stocking rates for combinations of animal species is controversial. The controversy centers around whether to consider diet overlap between species.

The conservative approach assumes different animal species eat the same plants and have 100 percent diet overlap. With this approach, total carrying capacity is simply determined according to animal numbers and animal units for each species. The rationale for this approach is that carrying capacity varies with terrain, season, weather and other factors, and therefore, diet overlap is too variable to try to estimate.

A second approach is to try to account for diet overlap. Most Texas studies suggest that potential diet overlap for cattle and goats is about 50 percent. In theory, then, these two species would not compete directly with each other. The following calculations estimate stocking rate for these two species using the diet overlap approach.

A ranch has an estimated carrying capacity of 100 animal units and the rancher wants to stock 100 Boer goats weighing 130 pounds as in the example above (5 Boer goats per animal unit) along with cows.

(100 Boer goats ÷ 5 goats/animal unit =
20 animal units)

(20 goat animal units x 0.5 diet overlap with cattle =
10 goat animal units)

(100 animal units - 10 goat animal units =
90 cow animal units)

If cows to be stocked weigh 1,150 pounds at body condition score 5, each cow is about 1.15 animal units (see calculation above).

(90 cow animal units ÷ 1.15 animal units per cow =
78 cows)

Estimated stocking rate: 78 1,150-pound cows and 100 130-pound Boer goats

If diet overlap is not considered, the total animals stocked in this example would be:

100 Boer goats ÷ 5 goats/animal unit =
20 goat animal units

100 animal units - 20 goat animal units =
80 cow animal units

80 cow animal units ÷ 1.15 animal units/cow =
70 cows

Estimated stocking rate: 70 1,150-pound cows and 100 130-pound Boer goats

Balancing Forage Supply and Demand

Flexible Stocking Rates

Many successful ranchers maintain flexibility in stocking rates. Flexibility is essential because rainfall is unevenly distributed both within and across years. In fact, records indicate that in one of every two years less than average rainfall will be received. Stocking based on average rainfall and forage production will overstock a ranch about 50 percent of the time. To be flexible, some managers devote 40 to 80 percent of their carrying capacity to stocker cattle and 20 to 60 percent to a cow-calf operation. This approach avoids the forced liquidation of the breeding herd in dry years.

Stocking Rate and Animal Performance

Heavy stocking rates are detrimental to both land resources and livestock performance. Over time, heavy stocking causes the more palatable and productive forage species to disappear. These desirable forages are replaced by less productive, less palatable plants that capture less rainfall, thus lowering the capacity of the soil to store moisture and increasing the risk of erosion.

Over the short term, a heavy stocking rate may lower forage quality by removing green foliage and forcing animals to consume more dead, standing forage. Over the long term, a heavy stocking rate removes almost all edible forage so that only immature plants remain. While this immature forage is high quality, there isn't enough of it. In grazing, both forage quality and forage quantity are important, and both affect livestock productivity and net profits.

Figure 3 illustrates the classic relationships among stocking rate, individual animal performance, gain per acre, and net profits. In the tallgrass prairie example shown here, individual animal gain decreases as stocking rate increases, while gain per acre increases. Net profits increase to a point, then decline. In contrast, in the midgrass prairie example represented in Figure 4, net returns decline rapidly from a peak at 5 acres per steer.

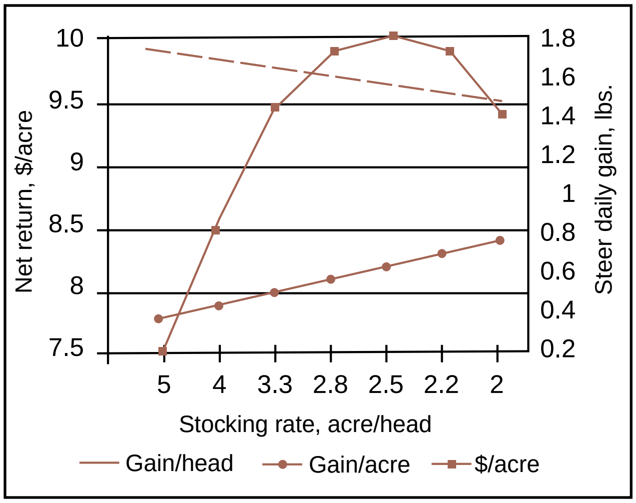

Figure 3. Relationships among stocking rate, individual steer gain, gain per acre, and net profits for a tallgrass prairie site.

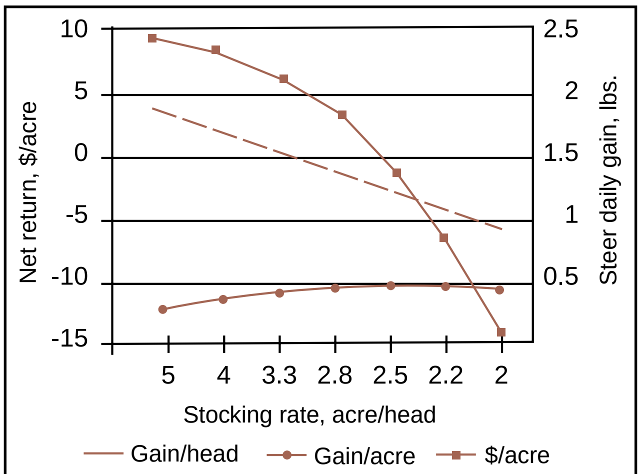

Figure 4. Relationships among stocking rate, individual steer gain, gain per acre, and net profits for a midgrass prairie site.

The effect of stocking rate also can be seen in cow performance. Figure 5 shows average body condition scores over 3 years at weaning, calving and breeding for spring- and fall-calving cows managed at different stock densities (acres per cow at a given point in time) on the same ranch. Body condition scores were higher for the fall-calving herd during each of these periods, particularly at calving. Cows in the spring herd were unable to improve body condition from weaning to calving. Fall-calving

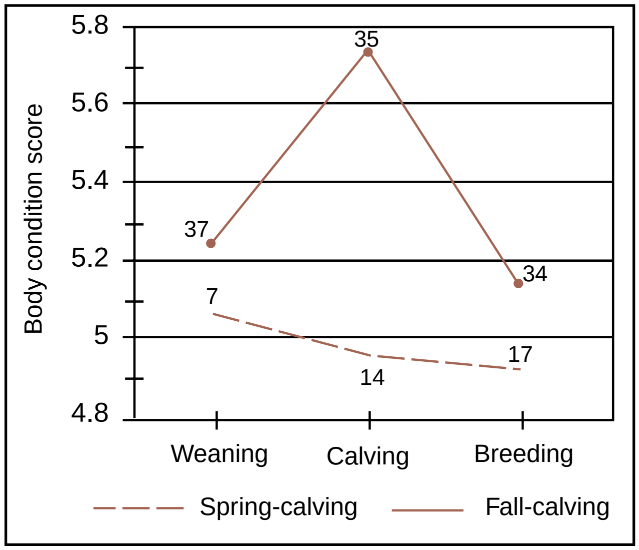

Figure 5. Effect of stock density (acres per cow for a given point in time) on cow body condition score in spring- and fall-calving herds on the same Hill County ranch. Numbers above lines indicate the stock density.

cows had two to five times more acres available per cow than spring-calving cows. The differences in body condition scores between the two herds were due mostly to differences in stock densities and related forage availability. The higher stock density (fewer acres per cow) in the spring-calving herd resulted in less available forage and lower condition scores. Spring herd condition score at breeding was about the same as at calving because these cows calved when forage quality was improving. Fall herd condition scores declined from calving to breeding because forage quality was declining during this period.

Forage Preference/Type Differences

Grazing/browsing livestock have forage preferences that can affect stocking rates. Research has shown that as much as 80 percent of a grazing animal's diet can come from as little as 1 percent of the forage standing crop.

Research in Oklahoma suggests that steer gain decreased at different rates on tallgrass and midgrass sites. With the same levels of decreasing forage availability, decline in weight gain was about four times faster on midgrass prairie. Reasons for these differences are not clear, but probably relate to forage preferences.

Animal adaptation to a forage type can have a significant effect on animal performance. For example, cattle are grazers, with about 80 percent of their annual diet consisting of grass. Cattle are not physically equipped to eat browse (leaves and twigs from woody vegetation). Therefore, stocking rates that force cattle to eat browse can drastically reduce forage intake. Figure 6 illustrates the effect of browse consumption on potential forage intake of steers grazing South Texas rangeland.

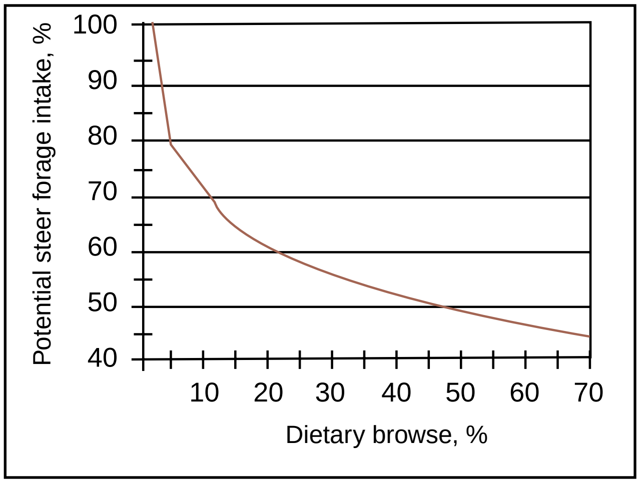

Figure 6. Effect of browse consumption on potential forage intake of beef steers grazing South Texas rangelands.

Recommendations

Although timing, intensity and frequency of grazing are important, stocking rate is the most important grazing management decision. Because stocking rate affects animal productivity, net profits, and the renewable range resource, it should be tailored to each pasture and ranch. Remember, to make maximum use of rainfall, leave enough forage residue or stubble to capture rainfall as soil moisture. Rainfall, forage production, and forage use by grazing animals are not static. Consequently, stocking rate flexibility is the key to sustainability and to protecting the range resource.

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