Healing the Land with High Stock Density

Mr. Doug Peterson

Iowa/Missouri Regional Soil Health Specialist, USDA-Natural Resources Conservation Service, Des Moines, Iowa

Healing the Land really means improving soil health. This is a talk about the soil but here is a freebie on economics for you. In case you hadn't noticed, fertilizer prices are a little higher than they have been in the past. If we want to be profitable in most cases, we must get away from annual expenses. Purchased soil amendments (fertilizer, lime, etc.) should be a capital investment, NOT an annual expense. What is a capital investment? It is an investment in property, buildings, or equipment that usually remain in use for several years. What is an annual expense? Seed, feed, and labor.

Animal Impact

How can we improve our soil without purchasing additional inputs? To quote Allan Savory from his book *Holistic Management*, "The only known tool to heal the land is animal impact." (Editor's note: I might add the word "pasture" in place of "the".) What is "Animal Impact"? Animal impact is everything that livestock do to the land. This includes dunging, urinating, hoof action, rubbing, salivating, and grazing. Animal impact is the most powerful tool we have to manage grassland resources. It effects utilization, reduces spot grazing, controls weed and brush competition, improves manure distribution, improves mineral cycling, water infiltration, and produces good seed/soil contact. Most of all it improves pasture soil health and other lands pastured a portion of the year or in a crop rotation.

Figure 13. Buffalo herd on rangeland

Building Soil

How did nature make all that soil in the first place on North American grasslands? The bison roamed around eating the grass. Primarily it was warm season grasses and forbs, but there was a tremendous amount of diversity. There is still discussion about exactly how the bison grazed. There were a lot of factors that came into play. Time of year, growing or dormant grasses, available water, what areas burned, what didn't burn, and a host of other things. Some writings and accounts say they were in small groups grazing only in the burned areas for the entire year. These burned areas would have been grazed pretty hard while unburned areas were almost ungrazed, and then the next year they moved to another burned area. There are also accounts of large herds numbering in the hundreds of thousands. As you can imagine when a large herd like this moved through

an area everything probably got grazed and/or trampled pretty hard. In either of these scenarios the grasslands were severely grazed and then rested for a long period of time, severely grazed, and then rested again. It was this type of grazing regime that developed some of the healthiest soils in the world. I think that we can use different forms of this type of grazing intensity and rest to repair our eroded and worn-out soils of today.

Stock Density

Stock density is a powerful tool. It can do lots of things. I believe that Allan Savory was probably the first person to really talk about the effects of stock density on the soil. He called it "Herd Effect". How do we measure "Animal impact"? By using stock density. Let's say we have 40 head of 1250 lb. cows. That is 50,000 pounds of beef on the hoof.

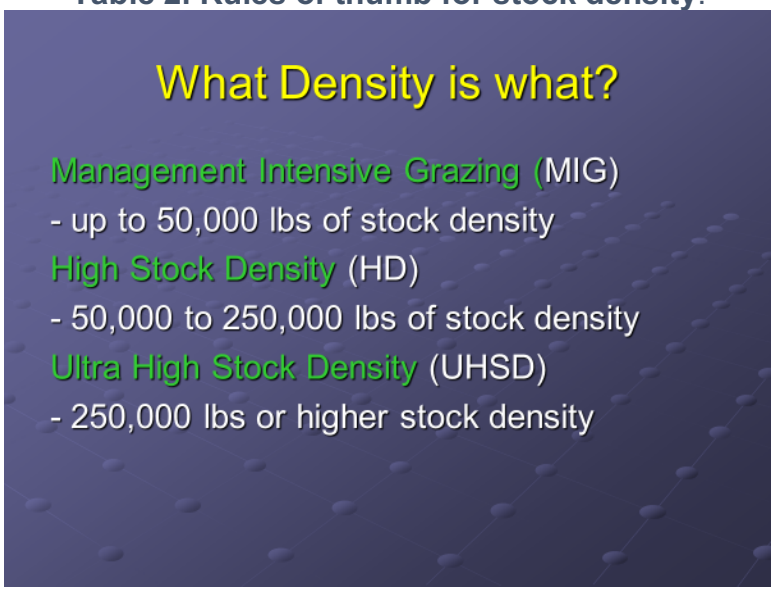
Table 1. Stock density as affected by size of paddock.

Stock Density	$\frac{\text{50,000 lbs Beef (40 cows)}}{\text{10 acres}}$ = 5000 lbs live weight / acre
Stock Density	$\frac{\text{50,000 lbs Beef (40 cows)}}{\text{1 acre}}$ = 50,000 lbs live weight / acre
Stock Density	$\frac{\text{50,000 lbs Beef (40 cows)}}{\text{1/4 acre}}$ = 200,000 lbs live weight / acre

I want to make sure everyone is really clear on this point. We are not talking about how many cows that we have on the entire farm. We are talking about how many pounds of livestock that we have concentrated on a given amount of land at any one time.

Can we keep these cows on the three different areas for the same length of time? No. Stock density really doesn't deal with time. It does affect how long something can be grazed, but the calculation of "Stock Density" doesn't figure in time.

Table 2. Rules of thumb for stock density.



These are just some guidelines that I sort of go by. There are no hard and fast rules. Seldom does MiG get above 50,000, and for 95% of folks, they don't get above 25,000.

UHSD can be called MiG, but MiG cannot always be called UHSD.

High stock density grazing is characterized as:
Grazing by relatively large numbers of animals at a high stock density for a short period of time

- Paddock Numbers: Infinite
- Grazing Period: Minutes – 1 day
- Rest period: months – years
- Stock Density: 50,000 lbs. – 1,000,000 lbs.
- Utilization: 20 – 80%
- Lowest selectivity

The picture below has a stock density that is close to 100,000 lbs. to the acre. Note the cow spacing. The muddy area in the foreground is where 200 pair were camped for the night when it rained almost 4 inches. Today you can't even see the area. You can see the 4 different strips in the picture. Take notice of how much is left after the cows move. We are not making them eat everything. These cows were March calving contract cows. This was June, and we were trying to get them bred so we were not being very hard on them. Utilization was about 50%. We were not back fencing every day. In MO, you can get away without back grazing about 4 days since regrowth will not start right away. The water source is located behind and below the camera location.

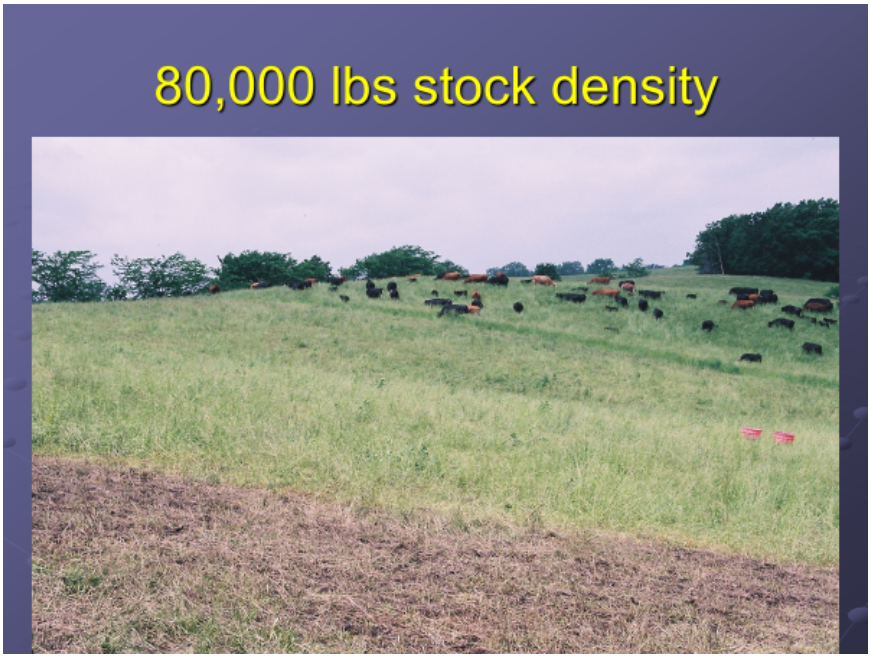


Figure 2. Beef cow/calf pairs at a high stock density.

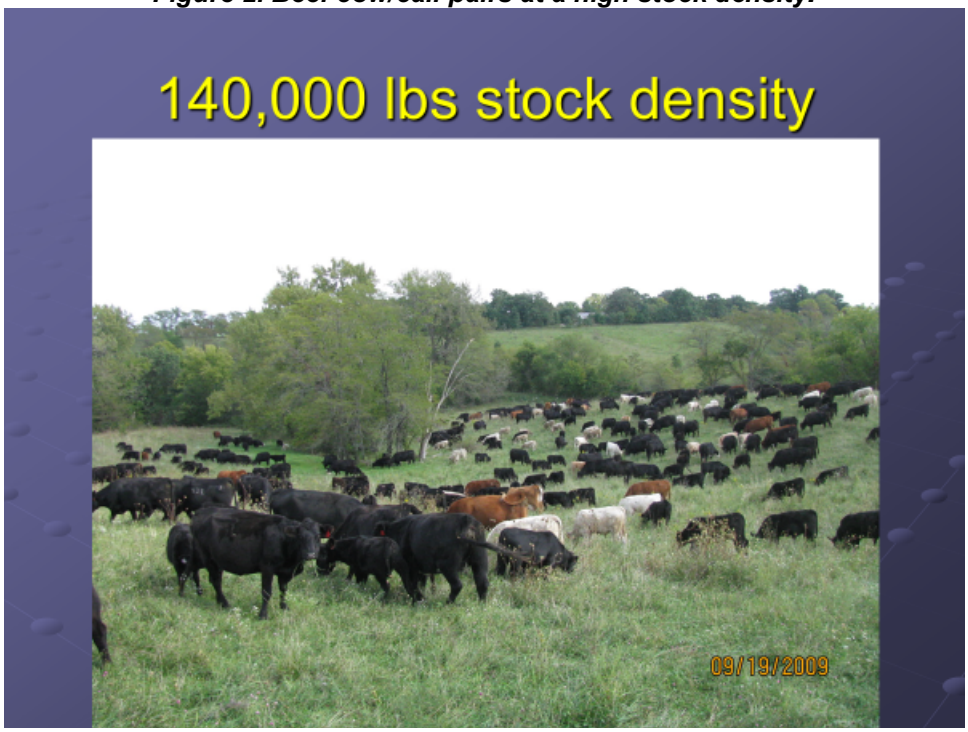


Figure 3. 250 cow/calf pairs on 3 acres.

Figure 3 above shows a set of cow/calf pairs at almost 150,000 stock density. Actually, the photo appears to be at a little higher stock density than that because the 250 pairs have access to 3 acres, but they are standing on only about 2 acres of the field. Again, we are looking at how closely they are spaced. When I talk to people about putting that many cattle on 2-3 acres they always ask, “Can they even fit on that small of an area”? Do they look smashed together to you? Do they look stressed to you?

Figure 4. Yearling beef cattle on summer annual pasture in Texas. Photos by Kirk Gadzia.

Photos were taken 10 minutes apart. Livestock moves were every 20 minutes. Cattle still have almost 10 minutes left to graze in the lower right photo.

500 head of 750 lbs. yearlings on ONE ACRE = 375,000 lbs. to the acre stock density.

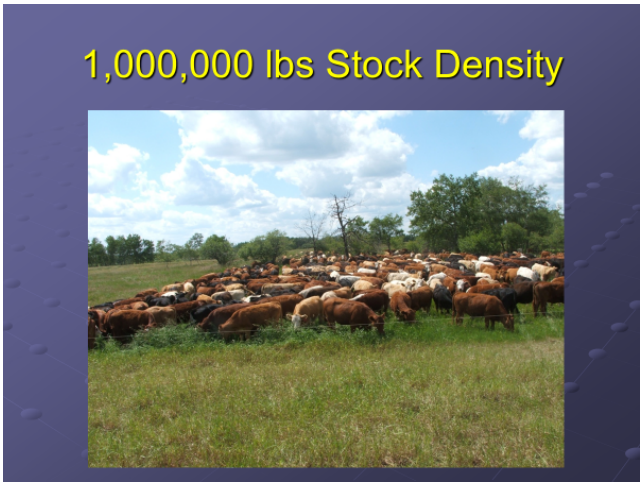


Figure 5. What a million pounds per acre looks like, right cozy.

How does High Density Stocking "heal the land"?

So, we have shown you exactly what High Density or Mob Grazing is. What is all the hoopla about "Mob" grazing??? Why are folks talking about it so much? Is it better than MiG? We are going to take a quick look at 5 areas of concern that I think make it significantly better than MiG. We begin with below ground (soil health improvement).

Table 3. How does High Density or Mob grazing differ from Management Intensive Grazing?

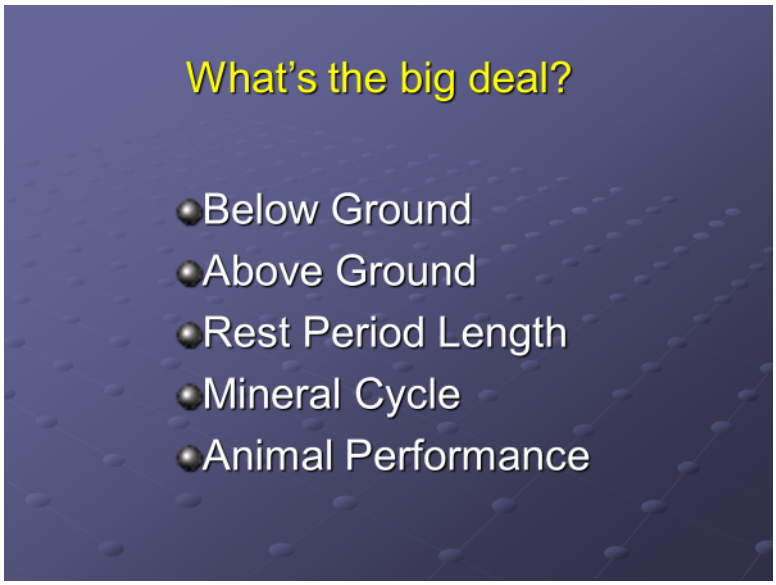


Figure 14. Clover growing where a hay bale had been fed previously.

Above is a photo of a little spot of clover in a mob grazed Missouri pasture. What made it? Any guesses? Yep, the rancher fed a bale of hay right there. You all have probably seen something very similar. You unrolled a bale and got a strip of clover or trefoil. What happened that stimulated the clover to grow there? Well, it got an increase in the soil organic matter (SOM), fertility, and water infiltration through the addition and trampling of plant material into the soil. The clover seed may have been in the soil seed bank or in the hay. Some of the original sod was smothered out too by the leftover hay residue. SOM

has a neutralizing effect on the soil pH. It can bring acid soil up and alkaline soil down towards neutral. So, the SOM helped correct the pH, got the microorganisms going, and then you have clover.

Can we heal the land just by adding carbon to the soil? In the photo below **(Figure 7)**, a field is shown that was rested from March through August in 2008. There was a lot of plant material here. Grass, broadleaf plants, just lots of stuff! Then, it was grazed and trampled at a stock density of about 150,000 lbs. per acre for about 12 hours. Not the half a million pounds that you may have read about, but higher than most MiG systems use. Did the cattle "waste" some grass? Well, they didn't eat everything that's for sure! They didn't eat it all, but it was all used for a specific purpose. It was trampled onto the surface of the soil creating a layer of mulch, just like the hay pile, that allowed the clover to

Figure 7. Pasture in August that was ungrazed since March of the same year.

germinate and grow **(Figure 8)**. The hoof action of the cattle is critical to getting the material in contact with the soil. In case you are wondering, no clover was broadcast on this field; no lime and no fertilizer applied for many, many years if ever.

Figure 8. Same field as above with soil seed bank clover released by 2 seasons of mob grazing.

Recently, I had the opportunity to talk to a USDA Soil Microbiologist. He said that it typically takes a couple years for the soil microorganisms to fully respond to the increase in decaying plant material. The mulch is a food source for all the microorganisms in the soil. The field pictured in **figures 7 and 8** has been managed for two years in this manner. I think because of the trampling, the natural nutrient cycle is starting to really kick in, and that is why we are seeing the clover increase.

Figure 9. Grazing residual heights of plants and length of rest between grazing affect root growth greatly.

In Missouri, we take soil samples to a depth of 6-8 inches. Originally it was done because that was the “plow layer” for annual crops. It is still a valid depth because most cool-season grass pastures are managed in a continuous grazing system and the plants only have root systems a few inches deep. There isn’t much need in going deeper because, for the most part, the plants just will not pull significant amounts of nutrients much deeper than 6 to12 inches. In areas that have deeper-rooted warm-season grasses, that will change some. Yet, almost all forage plants’ root mass reflects their above-ground biomass. Short tops mean short roots. In a really well-managed grazing system with fairly long rest periods, we can get cool-season plant roots that are several feet deep barring any root restrictive soil layers or bedrock.

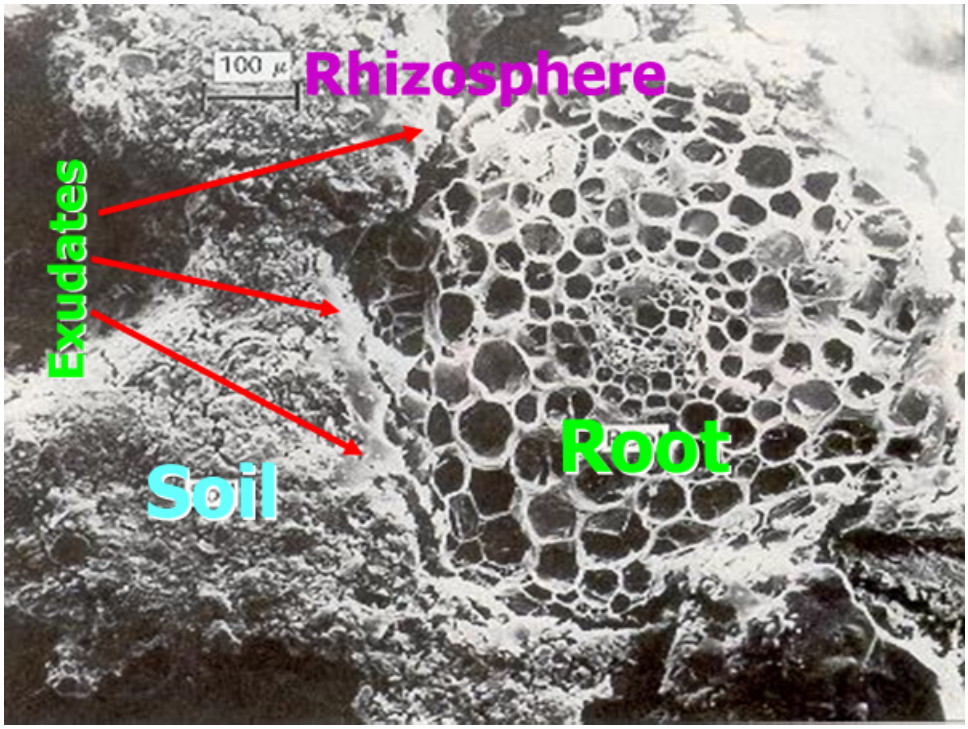


Figure 150. Electron microscope cross sectional view of a live root in soil oozing out exudates that feed soil microorganisms.

Here is how much soil “livestock” there is in a healthy soil: 8000 lbs. What do they all do? I am pretty sure I can’t tell you what they all do. I do not even know if I can tell you how many there are. See table 4 below. For those of you unfamiliar with higher mathematics, 15 zeros are a quadrillion and 18 zeros are a quintillion.

Can you tell me how many there are? Well, there are 800 quintillion bacteria, 20 quintillion actinomycetes, 200 trillion fungi, 4 billion algae, 2 trillion protozoa, 80 million nematodes, 40 thousand earthworms, and 8.16 million insects/arthropods.

I can tell you they are ALL critical to the soil health. For example, fungi act as root extensions. They attach to the roots and can extend 30-40 feet. Some of the others make minerals more available to plants. In effect, they make the plant roots 40 feet long. Each one is like a link in a chain. If one is killed or destroyed the entire chain will not work.

So, if we all have soil, do we all have these microorganisms and at these levels?????

Table 4. Good soil health expressed in terms of amount of soil lifeforms present.

Soil Health

Type of Organism	number/acre	pounds/acre
Bacteria	800,000,000,000,000,000,000	2,600
Actinomycetes	20,000,000,000,000,000,000	1,300
Fungi	200,000,000,000,000	2,600
Algae	4,000,000,000	90
Protozoa	2,000,000,000,000	90
Nematodes	80,000,000	45
Earthworms	40,000	445
Insects/arthropods	8,160,000	830

Soil Food Web

The second area of concern is above ground. Since high density grazing leaves a lot of residue on the soil surface: the soil is better protected from erosion, has improved water infiltration, is cooler and moister allowing for better plant and soil microorganism growth.

Figure 11. High density grazing of tall vegetation keeps the soil covered better than MiG grazing at lower stocking levels.

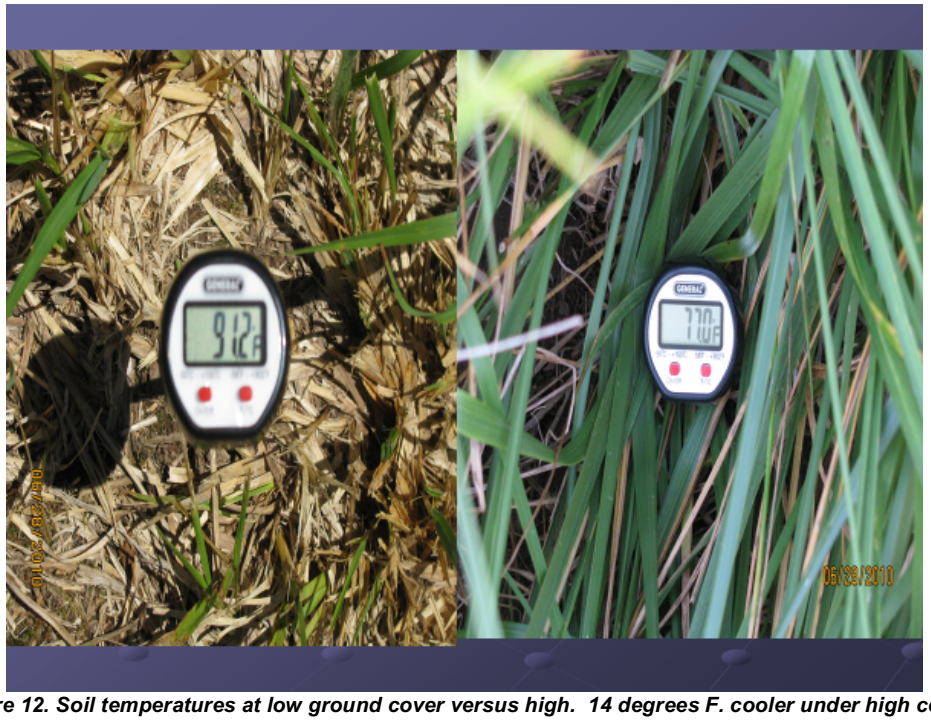


Figure 12. Soil temperatures at low ground cover versus high. 14 degrees F. cooler under high cover.

The sod slices in this rainfall simulation demonstration **(Figure 13)** were collected from actual pastures. The heavy rain was simulated on a 15% slope. Tray 3 is from an over-grazed and overstocked pasture, tray 2 is good rotational grazed and rested pasture system with only 4 inches of cover, and tray 1 same rotational grazed and rested system with only 6+ inches of cover after regrowth. The front jugs are runoff from surface; the rear jugs collected infiltration. Pretty graphic. This has been a great teaching tool for me at outdoor pasture training and education events.

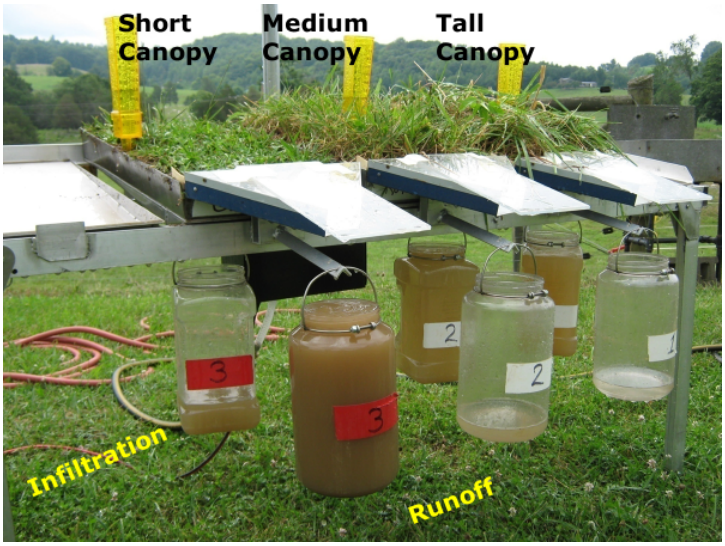


Figure 16. Rainfall simulator showing the differences in runoff, sediment loss, water infiltration from pasture sods taken from 3 differently managed pastures.

The short canopy pasture sod has filled the front jug to overflowing with runoff. The jug also has collected a lot of suspended sediment that washed off the soil surface of the

short canopy sod. Meanwhile, the back jug that collects infiltrated water through the sod has only 2-3 inches of water in it. Contrast this to the medium canopy pasture sod. Very little runoff has occurred. Its front jug has collected perhaps an inch of runoff and the water has very little suspended sediment in it. Meanwhile, its back jug is filled to its brim with infiltrated water. Some sediment has colored this infiltrated water. This would be much reduced if more of the soil profile was under the sod and the root system less disturbed during collection. Finally, with tall canopy pasture sod, runoff is even less and clearer than the medium canopy sod as can be seen in the front jug. The back jug interestingly has less infiltrated water in it and is slightly clearer. This can be a result of at least 3 things: more organic matter in the soil (retains more water) if the pasture has been managed this way a long time, more root mass binding the soil particles together better, and perhaps a bit more canopy interception of the applied rainfall.

High density grazing increases rest periods, the third area of concern. This causes:

- Lengthening rest periods means less grazing events per year in a paddock.
- Increases number of paddocks as they must be smaller to get desired density.

Utilizing all the plants helps extend recovery periods. This can help get rid of some undesirable brush and weeds along with the forage plants as selectivity is reduced when competition for the available herbage is keen among competitive grazers.

Figure 14. Sumac growing in a native pasture in MO.

Figure 15. Same native pasture after high density grazing occurred.

This rancher had been rotating twice daily at about 100,000 stock density. The cattle learned to eat sumac. No, he wasn't starving them. They didn't eat it last. They ate it right along with everything else. If it was in the front of the strip, they ate it first. If it was in the back of the strip, they ate it later on. They learned to JUST EAT whatever was there. Grass, legumes, sumac, weeds, whatever was available. Therefore, high density grazing can be a great vegetation control tool.

Figure 176. Ironweed grazed at 120,000 lbs. stock density.

There seems to be a change in grazing habits and animal behavior as you approach and get over 100,000 lbs. They will graze almost anything. But at 100,000, they still don't knock everything down. At higher densities, they will actually knock everything down to the ground, even coarser weeds and small woody plants. I think higher densities are better for the land, but it just takes more time. It requires more paddocks, more monitoring of forage availability, and more livestock moves. However, it takes less time to get pastures into better condition.

The fourth area of concern is mineral cycling. Again, high density grazing has the advantage. The most important factor is nutrient distribution. As livestock numbers or weight increase per unit of area, dung and urine are excreted much closer together and more uniformly since the livestock are more bunched and graze the entire area.

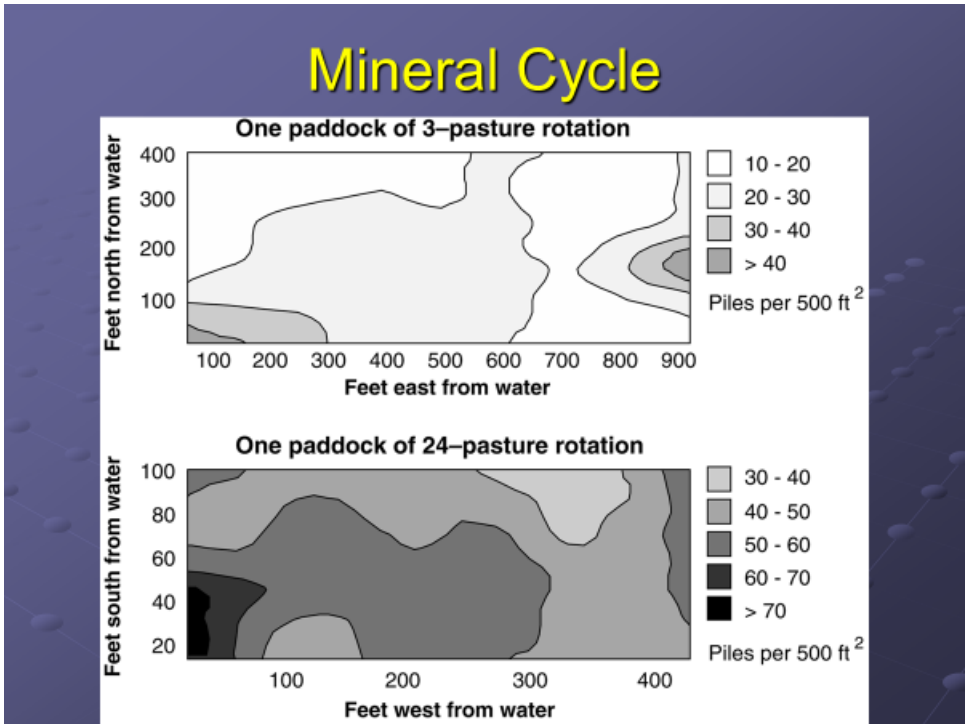


Figure 17. Distribution of dung piles as affected by number of paddocks with same herd size.

In the 3-paddock system (analogous to continuously grazed pastures) very few manure piles are deposited in the main paddock area. There is a concentration of manure near shade and water. I frequently ask audiences to identify the areas of the field where manure piles are most densely concentrated (shade, east end; water, southwest corner). Note its dimensions versus the 24-paddock dimension. This paddock is 360,000 square feet in size. While the 24-paddock system's paddock is only 45,000 square feet or 1/8th of the of 3-pasture rotation paddock.

In the intensively grazed 24-paddock system, there is a much more even distribution of manure piles in the pasture creating a higher density of manure piles in the main paddock area. There is still a concentration of nutrient near water, but the trends are less pronounced. Same head of livestock but stock density is 8 times denser.

Table 5. Rotation frequency effect on how many years to get 1 dung pile/sq. yard.

Mineral Cycle

Rotation Frequency	Years to Get 1 Pile/sq. yard
Continuous	27
14 day	8
4 day	4 – 5
2 day	2
1 time a day	??
2-6 times a day	??

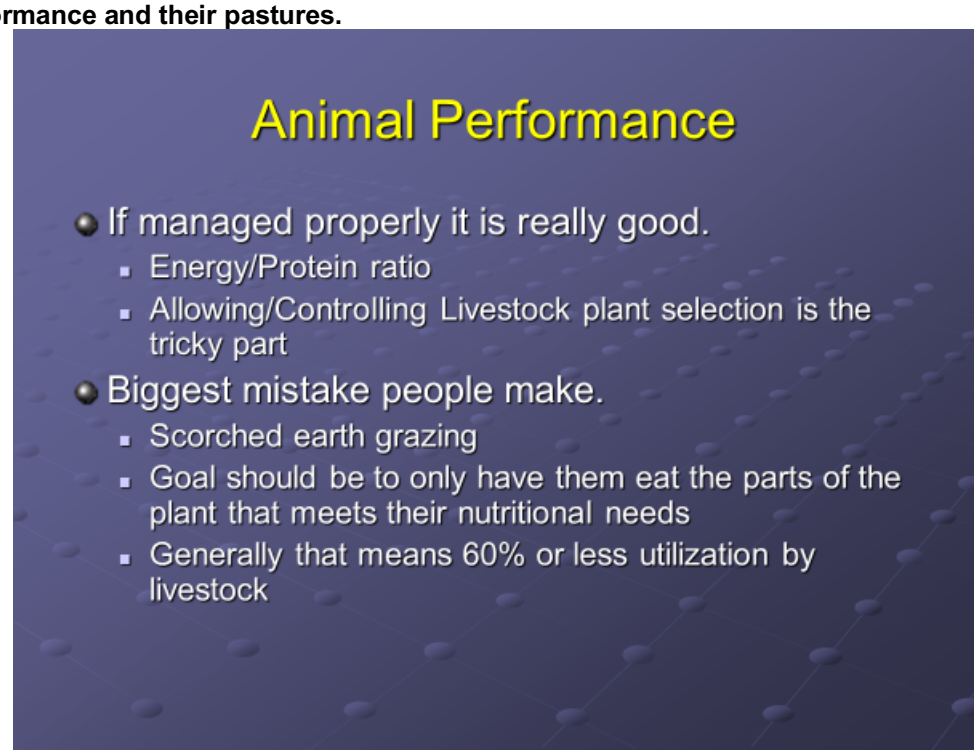
The table above shows some statistics in how long it takes to get 1 dung pile per square yard over the whole pasture. This all has to do with stock density. As rotation frequency increases, the less time it takes to get dung spread at 1 dung pile per square yard. In all likelihood, continuously grazed pastures may never see each square yard receive a dung pile. If the livestock are attracted to shade trees, hay bunks, water troughs, or gate openings, more and more dung piles will end up in the same few square yards repeatedly while other areas of the pasture will become more nutrient deficient as dung and urine are rarely placed there.

Figure18. Dung distribution at a stock density of 120,000 lbs.

Figure 18 is a photo taken of a once-a-day move at 120,000 lbs. density pasture. How close are the manure piles? How much of the area got covered with urine or manure?

The fifth and last area of concern is animal performance. More mature forage will tend to have a better energy to protein ratio that is more in line with certain livestock needs. Lactating dairy cows and pasture finished livestock require a higher plane of nutrition to keep milk flow or weight gain at desired levels. Thus, a younger, vegetative growth stage of more nutritious forage types is required for them. Care must be taken to be ready to move livestock piles. How long will it take every square yard to get a manure pile? There are 2-4 times as many urine patches as manure piles. They show up as green patches in this once they have reached the level of vegetation removal that keeps them and the pastures in good condition regardless of stock density levels.

Table 6. Animal performance on high density grazing must be closely monitored to avoid hurting their performance and their pastures.



The soil is the basis of everything. I believe the soil is the most important thing we have to take care of. HOWEVER, we have to consider the ‘’whole” when making management decisions. They are:

- Animal performance goals
- Financial goals
- Personal goals.