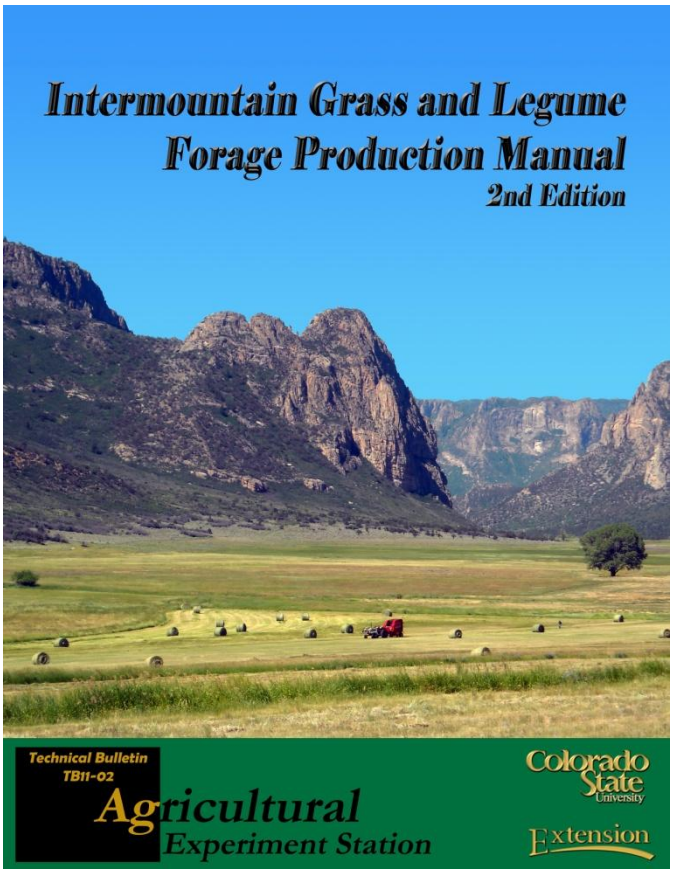

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Section I

Irrigated Pasture/Mountain Meadows

Chapter 8

Animal Grazing Management

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The FIO Principle

Plant responses to grazing can be defined in terms of three basic factors: (1) frequency of defoliation; (2) intensity of defoliation; and (3) opportunity for regrowth. This is referred to as the FIO principle. Each of these factors is closely related and should not be considered as singularly unique principles. Grazing management strategies should be designed with the overall principle in mind that includes all three factors.

1. Frequency of defoliation is simply the number of times a plant is defoliated during a period of time. Research shows that plant health is directly related to the number of times in which plant material is removed during the growing season. Responses to frequency of defoliation are related to season of removal, intensity of removal, and opportunity for regrowth. Grazing management strategies should be designed to reduce the potential number of times a plant is grazed in one season.
2. Intensity of defoliation is the proportional removal of plant material. The potentially negative effects of defoliation increase as intensity of defoliation increases. Moderate removal of leaf tissue during rapid growth stimulates additional leaf growth. Greater than 50 percent removal of leaf tissue may cause temporary cessation of growth and require the plant to draw on stored energy reserves for regrowth. Plant responses to intensity of defoliation are directly related to frequency and season of defoliation, and opportunity for regrowth. Grazing management strategies should be designed to increase the opportunity for regrowth as grazing intensity increases.
3. Opportunity for regrowth is probably the most important factor determining plant health and productivity. The amount of time needed for regrowth is determined by environmental influences (i.e., temperature and moisture), season of removal, previous defoliation events, frequency of defoliation, and intensity of defoliation. Opportunity for regrowth is also influenced by plant genetics. For example, crested wheatgrass has high genetic potential for regrowth, while bluebunch wheatgrass has low genetic potential.

Quality and Quantity of Forage

Animal responses to grazing are determined primarily by the quantity and quality of forage available to them. These two factors interact, but for simplicity of consideration, we will first look at them separately.

1. Quality is expressed as the concentration of nutrients in the herbage to be consumed. There are many measures of quality, such as crude protein, total digestible nutrients, digestible organic matter, cell content percentage, etc. Leaves are the highest quality part of the plant. They have the highest digestibility, the highest protein content, and the

highest concentration of most other nutrients. The younger the leaves, the higher the quality. This means that the uppermost grass leaves are the most nutritious, and that leaves produced following defoliation (regrowth) are of higher quality than original leaves at the same point in time.

Anti-quality compounds found in some plants have profound effects on either plant selection or its use by the animal once it is chosen. Examples of these are lignin, which accumulates in plants as they mature, reducing palatability and digestibility; and alkaloids, which also reduce palatability and digestibility and can be toxic at high enough concentrations.

Mixes of plants provide higher quality diets over longer seasons, due to inherent differences in nutrient composition, and because plants grow at different rates and in different seasons.

2. Quantity is the amount of forage available to the grazing animal. It is sometimes expressed in different time frames. For example, it may be useful to express forage availability in terms of the amount in a pasture per animal for the season, or at a point in time. **A word of caution:** animal choices for forage are always in terms of what is available when the choice is made. The choice has nothing to do with how many pounds per acre the land produces, or how many pounds per animal are available for the season. It should be specifically noted here that animals graze forage, not acres. Therefore, acres per animal may not be a very useful value unless there is additional information. All quantity is relative. Even though there may be a lot of pounds of grass on the ground, this does not necessarily mean the grazing animal has a lot to eat. Availability of forage is modified by plant palatability, plant height, livestock distribution, and many other factors.

Matching Plant Quality To Animal Needs

Quality versus quantity interactions are the key to livestock management in a pasture situation. A grazing animal has the capability to consume about 3% of its body weight per day on a dry matter basis. However, either forage availability or digestibility can reduce intake because the animal either cannot extend its grazing time, or the digestibility of the consumed forage limits passage rate so that additional forage cannot be consumed.

Animals grazing in the best conditions (high availability and high digestibility) consume approximately 2.5 to 3.0% of their body weight per day. This rate of consumption produces good livestock performance. The threshold for quality which restricts intake rate is approximately 55% digestibility and/or 7% crude protein for a mature cow with average milk production.

The threshold for quantity is relative to the type and structure of pasture being grazed. Several scientists agree that forage on offer per animal, per day, should be four to six times their daily dry matter intake; otherwise, availability is likely to limit intake.

Selectivity plays an important role in grazing management and animal performance. Animals pick and choose among the many types of forage in a pasture. As forage availability becomes greater, animals will choose a higher quality diet, up to some threshold. However, this threshold has not been fully identified. Animals with opportu-

nities to express selectivity will perform better than animals without that opportunity.

Animal responses to grazing are determined primarily by the quantity and quality of forage available to them

Designing A Grazing Management Plan

Every grazing management plan should, at its outset, have specified objectives. High livestock performance, efficient harvest of forage, and improved gross margins are important objectives in a ranching operation.

There are some terms which need to be defined before grazing systems can be properly evaluated.

1. Stocking rate is the number of animals on a given land area for a unit of time. This is frequently expressed in standard units, such as AUMs/acre (animal unit months per acre). In its truest form, stocking rate is an expression of forage demand. Current definitions of standard animal units are relatively crude, using average year-long demand to designate standard units. A cow in lactation demands 30% more nutrients than the same cow in gestation. Also, larger cows, and cows with greater milk production capability, require more nutrients than would be defined under the standard animal unit designation. Stocking rates need to reflect actual demand.
2. Stocking density is the number of animals per unit of land at an instant in time. This may be expressed as animals/acre or a standard unit, such as animal units/acre.
3. Herbage allowance is the amount of forage allocated to each animal for a unit of time. It is a useful term in defining forage availability. When pastures are well managed, herbage allowance and demand are balanced, and account for losses and inefficiencies in harvest.
4. Grazing pressure is the ratio between forage demand and forage availability.

Having established these terms, a more detailed discussion of grazing programs can be accomplished. Three management factors that can be manipulated in designing and implementing a grazing plan follow:

1. Time is the duration that animals stay on a given area. Changes in time regulate the amount of forage that is available per animal. By shortening the time, more forage per unit of time becomes available. Also, time has an influence on frequency and intensity of defoliation by altering the opportunity for livestock to regraze the same plant to a shorter length, or to graze regrowth.
2. Numbers refer to the number of animals on the pasture area. Without the time factor, this represents density. A change in numbers affects both total forage demand and forage availability per animal.
3. Area is the land available for grazing by livestock. Area can be either in reference to time, or without reference to time. A change in area simultaneously changes stocking density. Changes in area for a specified time reflect changes in stocking rate.

As you can see, all three control factors may have positive or negative effects on either plants or livestock, depending on how they are applied. The ideal grazing program

is one that matches the resources available with the needs of the grazing animal.

Pasture Management Is Really Leaf Management

It is extremely important that enough leaves remain during the growing season to manufacture food. Many factors influence how much a plant grows: rainfall, temperature, soil depth, soil texture, fertility, topography, and the inherent ability of the plant itself.

Yet, even when these factors are optimum, a plant can't grow without a large enough food-producing factory – its leaves.

This is the crux of grass management. The only major factor affecting grass growth that is fully in your control is the maintenance of the size of the leaf area - the plant's solar energy collectors that run the "food factory."

Except for grass you fertilize and irrigate, all other growth-influencing factors depend on Nature's provisions. Overgrazed grasses simply can't remain healthy, vigorous, and productive any more than a feedlot steer can gain well on only a maintenance ration.

This point, simple as it sounds, is something that just can't be overemphasized.

The effect of leaf defoliation on plant development has been studied many times. In general, there is agreement that grass production is substantially reduced when more than half the leaf volume is removed by grazing or mowing during the growing season.

An increase of one or two leaves on a grass tiller, when multiplied by millions of tillers, is the story of enhanced forage production in a pasture.

Good Roots Are Essential

Root systems are the unseen, but vital supply lines of moisture and nutrients to plant leaves. The depth that roots penetrate the soil varies among species.

Roots of many tall grasses, such as big bluestem, reach down ten to fourteen feet. Grasses with shorter growth characteristics, such as blue grama or buffalograss, may send roots four to six feet deep.

To some degree, the volume of roots and volume of leaves produced are in proportion.

It takes an extensive root system to supply water to a large volume of leaves. Depth and volume of roots are greatly influenced by grazing management. Scientific studies point out that excess removal of leaves has an adverse effect on root development and survival.

Why 30% Of All Grass Roots Must be Replaced Annually

Each year, a portion of a grass plant's roots die and are replaced with new roots. This is a natural function.

The amount of annual root replacement varies with different grasses, but it ranges from 20 to 50% of the total root system. It is necessary that these roots be replaced if the plant is to remain healthy and productive.

In one comprehensive test in which the effect of leaf removal on root development was studied, it was found that, in all grasses, the amount of leaf volume removed had a direct effect on growth of new roots. All root growth stopped for 12 days when 80% of the leaves were clipped. Removal of 90% of the leaves stopped all root growth for 18 days. These roots did not resume growth until the leaves were once more actively growing. The effects of repeated clipping impacted the amount of time root growth stopped. When 60% of the leaves were removed, only half of the roots ceased to grow, compared to when 50% of the leaves were removed and almost all the roots continued growing actively.

The Grazing Process

There are three fundamental processes that have an effect on the plant during grazing:

1. The grazing animal will either clip or tear off selected plant parts;
2. Plants are trampled and can suffer some mechanical damage; and, finally,
3. Fouling (manure and urine deposition) will occur.

All of these are part of the grazing process, but defoliation is the most important from the standpoint of effect on the plant, as well as its direct effect on the animal.

Understanding the defoliation process is important since its predictability is an integral part of any grazing management program. Livestock are selective in their choice of plants and consume the most palatable plants first. They also eat the most palatable plant parts first. Selective defoliation can be an important factor affecting the stability of multiple species pastures through its effect on individual plants. A seeded mixture should contain plants with similar palatability and growth form. If a less palatable grass is included in a mixture with a palatable species, the less palatable grass will soon dominate the pasture as a result of selective grazing.

Several factors determine what species of grass will dominate a pasture when certain grazing practices are employed. For example, if tall fescue is seeded with other cool-season grasses and the pasture is grazed continuously, in time, tall fescue will become the dominant grass. Tall fescue's dominance occurs as a result of two basic factors. First, tall fescue has its growing point exposed to grazing for a short period of time during the growing season. Second, tall fescue is less palatable than most other cool-season grasses. Consequently, when the pasture is grazed continuously, livestock are not repeatedly grazing or removing the leaf material of tall fescue and it gets ahead of the cattle. If a grass is not constantly having its leaf material removed, it has an opportunity to remain vigorous, produce seed, and increase. While tall fescue is gaining in vigor and dominance, the other more palatable, less grazing-resistant grasses are continuously having their regrowth grazed again and again and do not have an opportunity to accumulate leaf area and store carbohydrates. This results in loss of vigor and productivity.

Understanding the defoliation process is important since its predictability is an integral part of any grazing management program

The importance of understanding the inherent properties of each grass that is grown is critical to good grazing management. Used appropriately, tall fescue is a very productive grass and provides excellent spring, fall, and winter forage.

Defoliation

The net effect of defoliation can be either detrimental or beneficial. It is dependent on the severity of defoliation, as characterized by grazing height, frequency, duration, and rest interval.

Proper defoliation of a perennial grass is very beneficial. Most grass plants have evolved with grazing animals and are adapted to defoliation. When properly used, defoliation is advantageous, but there can be "too much of a good thing." Proper irrigation can be beneficial to crop yields; however, improper timing or amount can be detrimental. Fertilizer applications can dramatically increase yield while excess amounts are not only uneconomical, but can actually shift pasture composition and cause yield reductions. The usefulness of irrigation and fertilization is dependent on managerial skills. Plant defoliation should be viewed in

the same manner. When properly implemented, its effect can be as dramatic as irrigation or fertilization. When improperly done, its effect is devastating.

Proper defoliation can increase total production. If a grass is allowed to "head out," and is only harvested once at the end of the growing season, the total yield would be much less, and quality would be lower than if it were harvested several times during the growing season. If harvesting is done with consideration of plant requirements (i.e., water, fertilizer, height of cutting, frequency, etc.), the forage is maintained in an active growth and tillering phase longer than if it were allowed to mature naturally. As long as the plant is vigorous and an active growing point remains, forage production can continue. Forage growth rate declines as the plant nears maturity. Consequently, the goal of grazing management is to maintain the shoot in an active growth phase under the most suitable conditions for as long as possible, and then provide conditions for bud initiation and/or carbohydrate storage.

The degree of defoliation during the growing season should be designed to allow enough leaf area to remain to provide carbohydrates for regrowth rather than using stored carbohydrates. Previously, defoliation during the early stages of growth was thought to be most detrimental because root carbohydrate reserves were lowest at that point and regrowth required a major "draw down" of carbohydrates. However, vigorous plants have a great capacity to replenish carbohydrate reserves during the season of peak growth. Consequently, severe defoliation during the late part of the growing season is more detrimental than early-season defoliation followed by rest. Late in the season, environmental conditions do not favor the bursts of growth observed in the early season.

Most irrigated pasture grasses should not be grazed lower than four inches during the growing season. This provides sufficient leaf area for quick regrowth and maintains healthy pasture conditions. Species such as Kentucky bluegrass and perennial ryegrass can be grazed to 2 or 3 inches and still maintain enough leaf area for quick regrowth without drawing on carbohydrate reserves.

Remember: Energy reserves increase in crowns during the latter part of the growing season. In addition, buds are initiated for the development of next year's tillers. Consequently, severe defoliation near the end of the growing season reduces production of crown tissue and causes a decline in forage production the following year.

The importance of understanding the inherent properties of each grass that is grown is critical to good grazing management

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Practical Applications Of The Grazing Process

Generally, plants are not capable of supporting rapid growth in their shoots and roots simultaneously for an extended period of time. If pastures are grazed severely, root growth stops and roots may die back. If overgrazing continues, the grass has little leaf area to carry on photosynthesis, so the plant is low in energy. Leaf growth has "first call" on carbohydrates from photosynthesis, so there is no downward movement of carbohydrates for root growth. Roots then die back and the plant has only enough energy to maintain a shallow root system. The result is a pasture that is more susceptible to environmental factors, such as drought. Some plants may die, allowing weeds to invade. Even if plants stay alive, they would be less competitive, allowing more open ground for weeds to establish. This whole process accelerates as unfavorable conditions increase. The pasture begins a downward spiral which ends when the desirable pasture plants are

replaced by plants that are grazing-resistant because of low palatability or short growth form.

The grazing animal can be used to alter plant composition of a pasture. Coordinating the natural selectivity of livestock with the period of active growth of undesirable species is a useful management tool. Many times, shifts in species composition are the result of mismanagement. However, knowledge of plant growth and animal behavior enables the producer to cause a desired shift, rather than be a victim of an undesirable shift.

Remember: A livestock producer must visit his/her pastures frequently to check the livestock and the extent to which grasses are being grazed. Anticipate what is happening with the grasses and correct any potential problem before it is apparent in livestock performance.

Perennial forages are a renewable resource. They do not require planting every year, and they grow with predictable annual cycles. With a basic understanding of how grasses grow, knowledgeable manipulation of the grazing animal can enhance grass growth. Grazing without knowledge of grass growth could be compared to attempting artificial insemination without knowing the reproductive cycle of the cow.

Summary

1. Bud and carbohydrate management: Buds are formed during the growing season, prior to winter dormancy. Carbohydrates are stored late in the growing season. Consequently, fall management is a critical period, and adequate time should be provided after grazing and before dormancy for carbohydrate accumulation and bud development.
2. Remaining leaf area management: Adequate remaining leaf area minimizes carbohydrate depletion. This ensures continued root growth and carbohydrate storage for winter. Remaining leaf material also enhances the microclimate for growth during the growing season, and improves rain interception, insulation, and snow capture.
3. Defoliation: Optimum grazing management avoids repeated, severe defoliation of a tiller without a recovery period (planned non-use). Fresh growth is highly palatable and livestock will graze selectively. Therefore, the duration of livestock occupation must be controlled to optimize plant and animal production. Repeated severe defoliation of desirable plants or areas within a pasture can be reduced by increasing stocking density and reducing the duration of grazing.
4. Tiller management: Timely canopy removal can be used to stimulate tillering (regrowth). This is dependent on the species, environment, and previous management.
5. Livestock nutritional needs: To optimize animal performance (gain/head) and pasture production (gain/acre), the duration of non-use is critical. Non-use periods should be long enough to allow plants to recover from defoliation, but short enough to not allow plants to mature when pastures are used more than once per season. Successful grazing management must also consider the type of livestock and their nutritional needs. Producers must match the nutritional needs of their livestock, their management goals for livestock performance, and the seasonal quality of available forages.
6. Number of pastures in a grazing program: The number of pastures depends on water source and availability, forage species and mix, type of animal, growing season, and regrowth potential. For the majority of irrigated pastures, 5 to 8 paddocks (subdivisions) will provide for optimum plant and animal production and will allow for the objectives dis-

cussed earlier (controlling frequency, intensity, and opportunity to regrow) to be met. In addition, this will allow for an adequate period of recovery to maintain healthy root systems and pasture production.

7. Grazing program: Appropriate grazing management depends on the individual operation. When properly managed, controlled grazing programs allow stocking rates to be sustained at higher levels, compared to continuous, season-long grazing, because of improved harvest efficiency. Grazing distribution, season of grazing, and degree of use must all receive emphasis in the grazing program. Occasionally, it may be necessary to intensively graze a pasture late in the season. If the grass has been properly managed in previous years, it will recover from this late-season grazing; however, the same pasture should not be the last pasture grazed the following year.

Remember: Successful livestock production cannot be accomplished by ignoring either plant or animal requirements. It will require several pastures, a grazing plan, and a monitoring plan that detects changes in production and allows for changes to be made to maintain healthy pastures and animal production.