Appendix Chapter 10: How grazers change the pasture environment

Glenn Shewmaker and Scott Jensen, University of Idaho, gshew@uidaho.edu

This paper is an authorized reprint of Appendix Chapter 10 from PNW 708 Inland Pacific Northwest Pasture Calendar, Washington State University, Oregon State University, and University of Idaho

There is a truism for pasture and grazing management, "You get what you manage for." If you overstock or more likely allow continuous grazing, you will shift plant composition and form to grazing-resistant individual plants and species. Understocking or grazing with low stock density can create patch grazing patterns with some plants grazed too close and often, and some areas and plants that are not grazed. Sowing a pasture with the "best variety of grass" doesn't ensure long-term success. Although using good genetic resources is recommended, they will be overcome by poor grazing management in a few years. A pasture that resembles a golf green before seeding with a best new variety will still look like a golf green later if management does not change.

The converse can also happen. When good grazing management was applied on a previously continuously grazed pasture, we observed an obvious shift in plant composition from Kentucky bluegrass to orchard grass, meadow brome, tall fescue, and several legumes over three years. These more desirable species and plants existed in the pasture composition but were unable to be productive, with significantly reduced vigor. When plants were allowed to recover photosynthetic capacity from rest and buildup of carbohydrate reserves in the stubble and crown, plant vigor improved.

Different species require different stubble heights or residual—remaining vegetation after grazing—to 1) maintain photosynthetic capacity, 2) allow the growing point, apical meristem, to continue tiller extension, and 3) extend root growth. For example, perennial ryegrass will maintain only three leaves and is resistant to grazing, so the recommendation is to begin grazing at the 3-leaf stage on the majority of tillers. In contrast, smooth bromegrass will maintain many leaves and the recommendation is for longer rest between grazing events. On timothy at heading, 18 leaves have been counted per tiller prior to hay harvesting. Orchard grass is intermediate, but the leaves of this bunch grass stand erect and require a 4 to 5-inch stubble height to capture enough photosynthetically active light (figure 1) to remain vigorous.

Good grazing management positively impacts plant vigor. Vigorous plants will have deeper and more abundant roots. This results in more efficient water and nutrient uptake, and more effective photosynthesis. Better grazing management results in better pore space and water infiltration, more carbon sequestration, and improvement in other soil properties.

Grazing animals exert pressure on the ground comparable to crop tillage with agricultural machinery. The soil under pasture can be compacted and there is little opportunity to mitigate

poor soil physical conditions through tillage. Hence, it is important to understand the effects of grazing on physical soil properties and how this affects pasture growth and composition.

Grazing wet pastures will cause soils to be compacted to some extent, even those managed to minimize soil physical degradation. However, the magnitude of this compaction is usually small, and limited to the upper 2-6 inches of the soil. Compaction to greater depth, and other negative changes in physical soil properties, are more likely in recently tilled, wet soils.

Grazers affect how plants grow, and plant response to defoliation affects how grazers graze. There is variation in chemical composition and thus nutrient concentration within the vertical distribution of forage available to grazers. The proportion of leaf material decreases, and the proportion of stem and dead material increases resulting in reduced nutrient concentration as the animal grazes progressively down through the sward. Grazing modifies plant morphology and chemical composition. Repeated defoliations of the same area will result in a reduction of bite mass, intake rate, and crude protein and sugar content, but an increase in structural carbohydrate content of the material ingested. Thus, increased grazing time and decreased bite mass common on short swards as compared with taller swards, as well as increased rumen fill and increased amounts of energy gained from rumen fermentation end products, were found after longer regrowth of pasture (Chilibroste et al., 2000).

Performance of high-producing livestock, such as lactating dairy cows or finishing cattle, can be limited by forage intake. Forage intake is primarily a function of biting rate, grazing time, and dry matter (DM) intake rate:

> Forage intake = biting rate (bites/minute) x grazing time (minutes/day) x intake rate (grams DM/bite)

Cows work hard seven days a week, 365 days a year. Their survival depends on it. They also belong to the cow union, however, and will not graze more than about 12 hours per day! They must also have time to ruminate or “chew their cud,” meaning they regurgitate their food and chew it again.

There is also a limit to how many bites animals can take per minute. High-producing dairy cows may have biting rates of up to 60 bites per minute (40,000 bites per day), while low-producing cows may take only about 25,000 bites per day.

With limited grazing time and bites per minute, animals must maximize the amount of intake per bite. If they do not get enough sustenance in 12 hours, they will lose weight or exhibit decreases in production. Sward height and mass affect bite size and intake rate. A pasture must have at least 2,000 pounds of forage DM available for an animal to realize 100 percent of its intake potential (figure 2). Thus, managing pastures to maintain proper sward height and density can influence grazing behavior for optimal intake.

Your goal for grazing animals is to optimize intake. Several animal and pasture factors influence intake rates. As a manager, you can manipulate these factors to improve intake. Keep the following factors for bite size and sward characteristics in mind (Crane et. al. 2010):

Bite size:

- Bite size (ounces of forage dry matter per bite) has a greater influence on intake than does bite rate or grazing time.
- Bite size increases with forage quality and leaf density.
- At a feeding station, cattle graze in horizons from the top of the sward to the soil surface. Higher horizons provide deeper, heavier bites.

Sward characteristics:

- Optimal intake on pastures is often limited by herbage height (low vertical density). As sward height decreases, bite size declines and grazing time must increase. Conversely, intake on rangelands is limited by herbage density (low horizontal density).
- On grazed pastures, bite size and intake generally increase with forage abundance and height. However, animal gain has not been shown to necessarily increase with the height of grass. Digestibility often decreases as forage height increases. Additionally, lodging and trampling are more likely to occur and may decrease access to leaves of forage plants.
- The presence and accessibility of leaf material are both important factors in forage quality. For example, switchgrass has a lower proportion of leaves to stems than bermudagrass, but it produces better cattle gains because leaves are more accessible (taller).
- Large herbivores are at a disadvantage when grazing short swards because each bite represents a smaller portion of daily requirements.
- Animal diets are higher in quality than the overall quality of the pasture because animals can select leaves over stems and live portions of plants over dead portions.
- Cattle will select “normal” over lodged swards, but it is possible to maintain intake rates on lodged swards.

Good grazing management will improve livestock productivity as measured by average daily gain or milk production. For example, Abrahamse et al. (2008) confirmed that increased pasture allocation frequency from once every 4 days to once a day improved milk production in grazing dairy cows, especially when the amount of pasture availability was high. This was mainly the result of a change in grazing behavior, resulting in an increase in pasture dry matter intake. Concentrations of crude protein and sugars decline with each day in the same pasture as livestock selectively graze the most desirable plants first, while concentrations of neutral detergent fiber and lignin increased each day of continuous pasture grazing.

Summary

Good grazing management affects plant species abundance, plant vigor and growth characteristics of pasture plants. Good grazing management maintains plant vigor, which results in deeper and more abundant roots. This results in more efficient water and nutrient uptake, and more effective photosynthesis. Better grazing management results in better soil pore spaces and water infiltration, more carbon sequestration, and improvement in other soil properties. These practices influence how grazers affect the environment.

Intensive management and rotational grazing systems can optimize production per livestock unit and per acre. Intensive grazing management allows for abundant forage or pasture height which affects bite size, the major factor controlling pasture intake. If a grazing manager allows livestock to regraze a pasture or overconsume the forage by continuous stocking, as pasture height decreases:

A. Bite size decreases
B. Biting rate increases
C. Grazing time must increase

Although forage dry matter intake can be maintained temporarily by the grazer adjusting with the above rates in B and C, there are physical limits to these relationships and soon animal production becomes limited. Grazing animals don't plan for the next days feed, they just eat the best feed available until it is gone. Grazing managers should plan for the grazers and allocate forage to them for optimal livestock production.

References cited

Abrahamse, P.A., J. Dijkstra, B. Vlaeminck, and S. Tamminga. 2008. Frequent Allocation of Rotationally Grazed Dairy Cows Changes Grazing Behavior and Improves Productivity. *J. Dairy Sci*. 91:2033–2045 doi:10.3168/jds.2007-0579

Chilibroste, P., S. Tamminga, H. Boer, M.J. Gibb, and G. den Dikken. 2000. Duration of Regrowth of Ryegrass (*Lolium perenne*) Effects on Grazing Behavior, Intake, Rumen Fill, and Fermentation of Lactating Dairy Cows. *Journal of Dairy Science*, Volume 83, Issue 5, 984 - 995

Crane, K., J.B. Glaze, and G.E. Shewmaker. 2010. Chapter 13: Forging Behavior and Grazing Management. p. 133-138. In Shewmaker, G.E. and M.G. Bohle (eds.) Pasture and Grazing Management in the Northwest, PNW Bulletin 614, University of Idaho Extension, Moscow, ID.

Shewmaker, G.E., and L.K. Hooper. 2013. Sward structure effects on light interception in rotationally-grazed orchardgrass (*Dactylis glomerata* L.). p. 1049-1050 In (eds.) USB drive, Proceedings 22nd Int. Grassland Congress, 15-19 September 2013, Sydney, Australia.

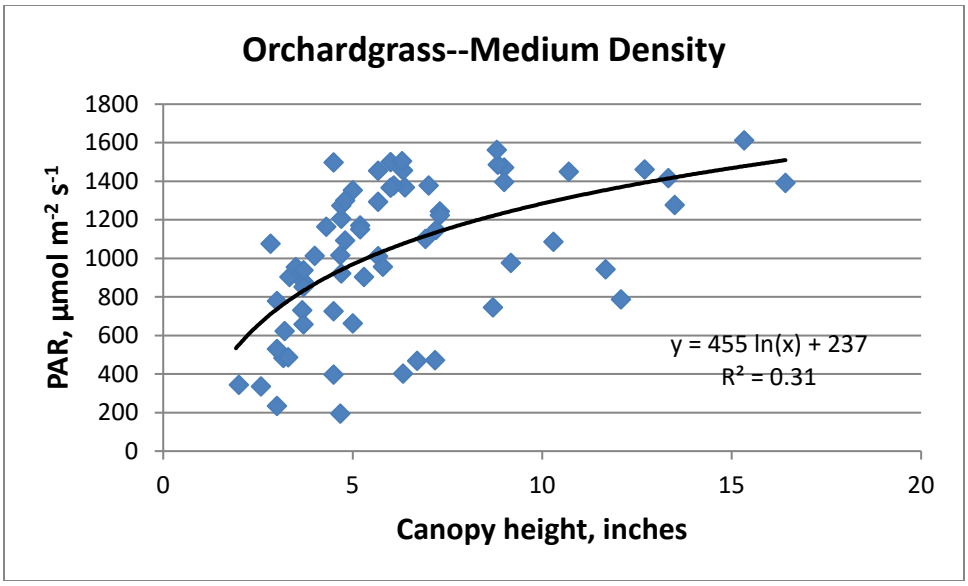

Figure 1. Photosynthetically active radiation (PAR) intercepted by Dactylis glomerata canopies as a function of canopy (sward) height in medium canopy densities across 2 growing seasons and 2 sites in south-central Idaho (Shewmaker and Hooper 2013).

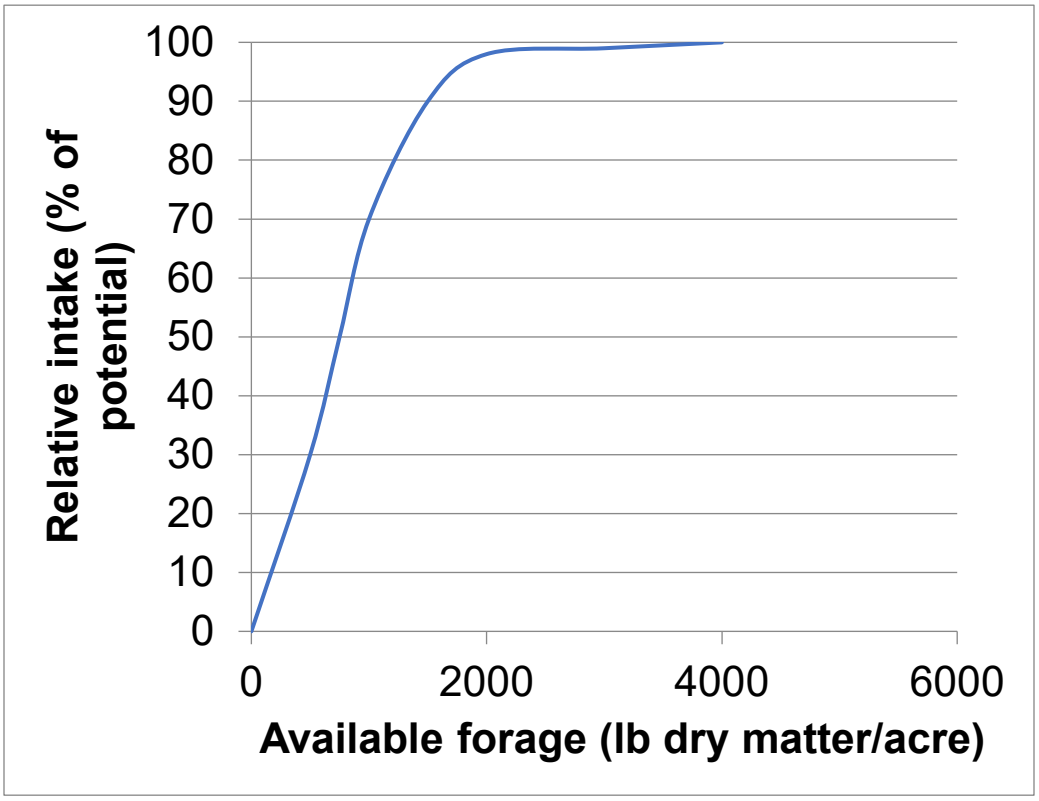

Figure 2. Availability of forage affects animal dry matter intake. (Adapted from Martz, Tate, and Gerrish. 1999. Meeting nutritional needs of livestock from pasture. In Gerrish, J. and C. Roberts, eds. Missouri Grazing Manual. MU Extension, University of Missouri-Columbia)