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Grazing and Harvest Efficiency of Forage by Cattle on Western Rangelands

Ruger Carter, Dr. Eric Thacker, Kevin Heaton, Beth Burritt

Introduction

Selecting the correct stocking rate is one of the most important range management decisions a land manager can make (Holechek et al. 1999). To avoid overgrazing that could lead to degradation of rangelands, many land managers use the take half, leave half method where 50% of the forage is allocated to livestock, and 50% is left for range and watershed health (Green and Brazee, 2012). However, not all the forage allocated to livestock is consumed by the animals. During grazing, part of the forage used by livestock is "ingested," and part is "wasted" through trampling or spoilage via, manure, urine, and bedding (Green and Brazee 2012, Galt et al. 2000). Other factors not attributed to livestock that can utilize forage include wildlife, insects, and weathering (Quin 1970). Calculating a stocking rate based on estimates of how much the animals consumes, and not considering waste could lead to over-utilizing rangeland.

To select a proper stocking rate that reduces the risk of overgrazing, harvest efficiency needs to be considered. The National Range and Pasture Handbook (NRPH) (Butler et al. 2003) defines harvest efficiency as "The percentage of forage actually ingested by the animals from the total forage produced." This harvest efficiency percentage shows how much forage is being consumed by the target animals.

Equation for Harvest Efficiency:
*Intake / Total Forage Production * 100 = Harvest Efficiency Percentage*

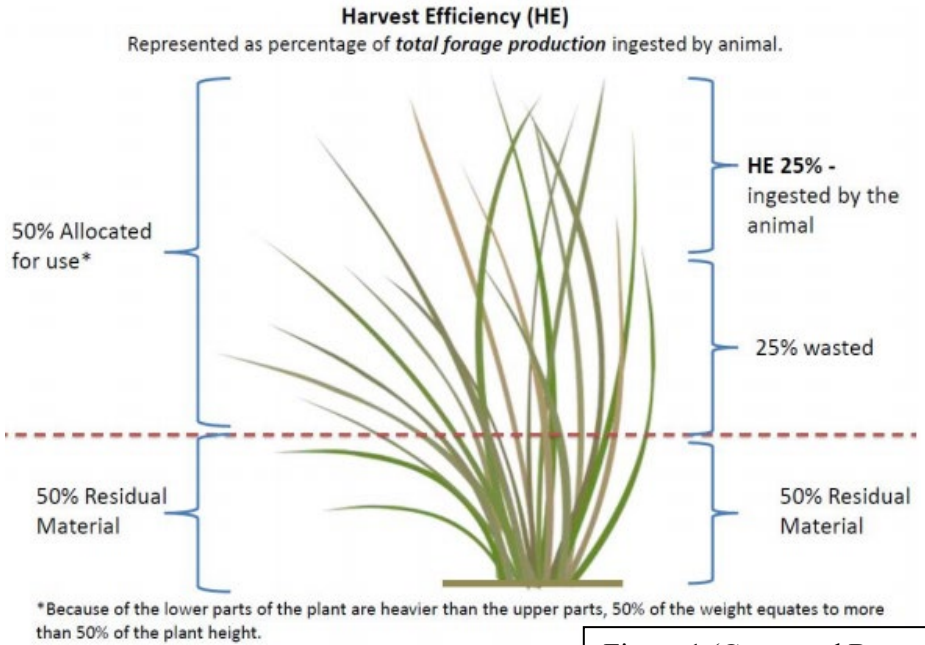

Figure 1 (Green and Brazee 2012)

Understanding the difference between grazing efficiency and harvest efficiency is also helpful. The NRCS defines grazing efficiency as, "Of all forage utilized (this includes what is wasted), that portion actually ingested by the animal is grazing efficiency." (Green and Brazee 2012). Grazing efficiency is closely related to harvest efficiency and gives an estimate of how much of the allocated forage is being consumed and how much is being wasted.

Equation for grazing efficiency:

*Intake/ Total Forage Production - Residual) * 100 = Grazing Efficiency. (Figure 2 Green and Brazee 2012)*

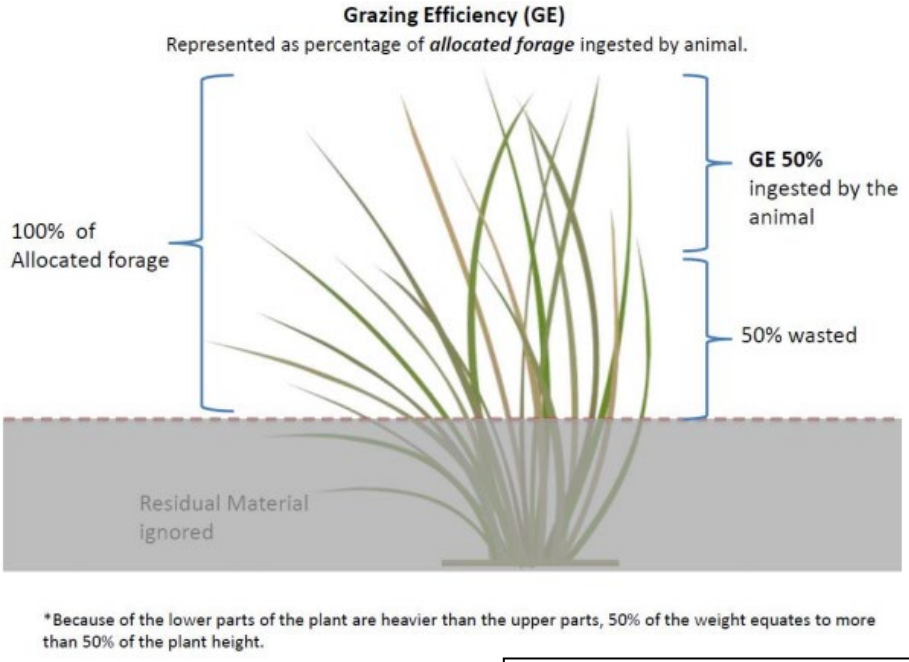

Figure 2 (Green and Brazee 2012)

Implications

Harvest and grazing efficiency are a way to help land managers better adjust stocking rates to ensure long-term rangeland productivity. In order to increase harvest efficiency managers can increase the stocking density and shorten the pasture timing in order to waste less forage. This happens because livestock will consume forage before it can be wasted.

Calculating a Stocking Rate Using Harvest Efficiency

To select a stocking rate using harvest efficiency, you must first calculate total forage production then multiply total forage production by the harvest efficiency for your rangeland. This will give you total forage available for consumption. You can then divide that by the expected monthly intake per animal, which will give you the number of animal unit months.

Calculating Animal Unit Months Using Harvest Efficiency:

*Pounds of Forage per Acre * Number of Acres = Total Pounds of Production*

*Total Pounds of Production * Harvest Efficiency = Forage Available for Consumption*

Forage Available for Consumption / Expected Monthly Intake Per Animal = Number of Animal Unit Months

Example:

*1,000 Pounds of Forage per Acre * 100 Acres = 100,000 Pounds of Total Forage*

*100,000 lbs. Total Forage Production * 25% Harvest Efficiency = 25,000 lbs. Forage Available for Consumption*

25,000 lbs. of Forage Available for Consumption / 900 lbs. Expected Monthly Intake = 27.78 Animal Unit Months*

**900 lbs. is the expected monthly intake for a 1,000 lb. cow eating 3% of her body weight*

Calculating a Stocking Rate Using Grazing Efficiency

To select a stocking rate using grazing efficiency, first calculate total forage production, and then multiply that by desired utilization percentage. This will give you the total forage available for utilization. You then take the total forage available for utilization and multiply that by the grazing efficiency to calculate the amount of forage to be consumed. You can then divide that by the expected monthly intake per animal, which will give you the number of animal unit months or AUMs. Note that grazing efficiency and harvest efficiency are both related and using each method to calculate a stocking rate will produce the same result.

Calculating Animal Unit Months Using Grazing Efficiency:

*Pounds of Forage per Acre * Number of Acres = Total Pounds of Production*

*Total Pounds of Production * Desired Utilization = Available Forage*

*Available Forage * Grazing Efficiency = Forage Available for Consumption*

Forage Available for Consumption / Expected Monthly Intake = Number of Animal Unit Months

Example:

*1,000 Pounds of Forage per Acre * 100 Acres = 100,000 Pounds of Total Forage Production*

*100,000 lbs. Total Forage Production * 50% Utilization = 50,000 lbs. Available Forage.*

*50,000 lbs. Available Forage * 50% Grazing Efficiency = 25,000 lbs. Forage Available for Consumption*

25,000 lbs. Forage Available for Consumption / 913 lbs. Expected Monthly Intake = 27.38 Animal Unit Months*

**900 lbs. is the expected monthly intake for a 1,000 lb. cow eating 3% of her body weight*

Limitations

Current research on harvest and grazing efficiency has been conducted on the Great Plains in a mixed-grass prairie vegetation type. This research found that moderate stocking rates with 50% utilization have a harvest efficiency of 25%, meaning approximately 25% of the forage is wasted and or spoiled. However, little is known how harvest efficiency differs in other rangeland types, especially more arid range types dominated by bunch grasses and shrubs.

Balph and Malecheck found that cattle avoid stepping on elevated bunch grasses, which would decrease the amount of waste by trampling in bunch-grass dominated systems. (Balph and Malecheck 1985). This would increase harvest efficiency due to less forage being trampled and wasted by livestock, leaving more forage for consumption. Large interspaces between plants would also decrease waste from defecation, urination, and bedding. Therefore, harvest efficiency coefficients from the Great Plains may not be applicable to grazing in more arid bunchgrass dominated rangelands.

Currently, there is a lack of research being conducted on harvest on arid bunchgrass rangelands. There is a need for research projects that evaluate harvest efficiency. Until then, Galt et al 2000 recommends a harvest efficiency coefficient of 25% to reach utilization levels of 30-35% for most western rangelands. This would allow livestock to consume 25% of the forage, while 10-15% of forage is utilized through trampling, wildlife, and weathering.

Table 1: List of Recommended Harvest Efficiency Percentages for Western Rangelands

Author	Location of Study	Recommended Harvest Efficiency Percentage	Utilization
Smart et al. 2010	Great Plains	25%	50%
Galt et al. 2000	Chihuahua Desert of New Mexico	25%	30-35%
Paulsen and Ares 1962	Mixed Grass-Shrub Ranges of Arizona and New Mexico	30%	35%

Recommendations

Harvest efficiency and grazing efficiency are affected by utilization rate, forage type, forage maturity, forage distribution, topography, and livestock distribution. This can complicate the process of choosing a stocking rate that reaches proper utilization.

We recommend refining stocking rate using a harvest efficiency percentage based on your rangeland and management goals. After setting a stocking rate, closely monitor the rangeland to see if utilization goals are being met. If utilization is below the management goal, stocking rates can be increased. On the contrary, if utilization is above the management objective, stocking rates will need to be lowered. By following these guidelines, you will be able to reach an appropriate level of utilization that increases animal and rangeland health.

Citations

Balph, D. F., & Malecheck, J. C. (1985). Cattle trampling of crested wheatgrass under short-duration grazing. *Journal of Range Management*, *38*(3), 226-227.

Butler, L., Cropper, J., Johnson, R., Norman, A., Peacock, G., Shaver, P., & Spaeth, K. (2003). National range and pasture handbook. *United States Department of Agriculture, National Resources Conservation Service*.

Galt, D., Molinar, F., Navarro, J., Joseph, J., & Holechek, J. (2000). Grazing capacity andstocking rate. *Rangelands*, 22(6), 7-11.

Green, S., & Brazee, B. (2012). Harvest Efficiency in Prescribed Grazing (Technical Note No. TN Range No. 73). *USDA National Resources Conservation Service, Boise, Idaho*.

Holechek, J.L. & Thomas, M & Molinar, F & Galt, D. (1999*).* Stocking desert rangelands: What we've learned. *Rangelands*. 21. 8-12.

Paulsen, H. A., & Ares, F. N. (1962). Grazing values and management of black grama and tobosa grasslands and associated shrub ranges of the Southwest (No. 1270). *US Department of Agriculture.*Quinn, J. A., & Hervey, D. F. (1970). Trampling losses and travel by cattle on sandhills range. *Rangeland Ecology & Management/Journal of Range Management Archives*, 23(1), 50-55.

Smart, A. J., Derner, J. D., Hendrickson, J. R., Gillen, R. L., Dunn, B. H., Mousel, E. M., Johnson, P. S., Gates, R. N., Sedivec, K. K., Harmoney, K. R., & Volesky, J. D. (2010). Effects of grazing pressure on efficiency of grazing on North American Great Plains rangelands. *Rangeland Ecology & Management*, 63(4), 397-406.

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