Utilization Guidelines

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Utilization usually is expressed as a percentage of the height or weight of forage plants which has been removed by grazing. It can also be expressed as the height or weight of plant material remaining on forage plants after grazing. Utilization estimates are widely used for adjusting stocking rates, identification of distribution patterns, as a measure of grazing pressure on the vegetation which may allow prediction of effects on the plants or the animals, and as stated management goals. These estimates by themselves should not be goals but instead should be evaluated to determine if they are appropriate indices to make reliable management decisions. How utilization is defined, what is measured, how it is measured and when it is measured all affect how well a utilization estimate correlates with a specific effect on the resource.

How should utilization be defined?

The Society for Range Management definition of utilization is "the proportion of the current year's biomass production which is removed or damaged by grazing animals" (Glossary Revision Special Committee 1989). This obviously does not apply when a "residue" method is used.

Strict interpretation of this definition means that the current annual aboveground net primary production must be known. This is almost never true and in reality most utilization studies use peak standing crop as the estimate for current year production. Peak standing crop is always less than total production, so there is a built-in bias of overestimating utilization compared to the definition of utilization. Utilization most often is measured as the percentage of the standing crop of forage present removed by grazing at a time other than when the total year's biomass is present, usually restricting "standing crop" to current year's production to date. This creates a major problem in interpreting utilization data.

When utilization is measured near the end of the growing season, peak standing crop can be estimated and the percent utilization calculated if regrowth on grazed plants is accounted for or ignored. If utilization is measured at any other time of year, say in the growing season or at the end of a dormant season, peak standing crop cannot be measured at the time the forage is utilized. Usually, ungrazed "production" is estimated at the time utilization is measured. Removal of a certain quantity of forage will produce higher percentage utilization if expressed in terms either of mid-growing season or end-of-dormant season standing crop than it would if based on peak standing crop.

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DeMuth (1990) illustrated this point by clipping sideoats grama plants to reflect moderate (6 in. stubble height) and heavy (3 in. stubble height) grazing. She referred to utilization based on other than peak standing crop as relative utilization. Relative utilization ((1-(forage present/current years growth to date))X100) in April was 17% and 49% for moderate and heavy utilization, respectively. When the actual utilization ((1-(forage present/peak standing crop))X100) was calculated, the percent use was only 6% and 17% for the moderate and heavy utilization treatments, respectively. The same relationship was evident with a June clipping, with relative utilization of 14% and 63% and actual utilization of 6% and 23% for the moderate and heavy grazing treatments, respectively. This over-estimation of utilization is logical, as plants continue to grow after growing season grazing ceases. This over-estimation is common in the evaluation of grazing systems and often is used erroneously to adjust grazing animal numbers. Either utilization guidelines must be adjusted to be realistic estimates prior to peak growth as indices for management decisions, or use estimates should be made at the time of peak standing crop.

Regardless of which measure of production is used, there remains the problem of identifying "current year's" growth. In some cases this is not difficult but in some it is next to impossible, as on some evergreen shrubs. Even on perennial grasses "recent standing dead" may be transformed into "old standing dead" in a very short time (Haile, 1981; Oba, 1986). In some areas, e.g. Arizona, there is even some question as to what constitutes the "current year", i.e. if utilization is measured in June, is regrowth on plants grazed last fall considered current year's growth even though the growth that was grazed was produced last summer and maybe even in the spring before that? If so, the current year's growth really is produced over a 15-month period and overlaps with the next and preceding years.

When utilization is measured at the end of a grazing season which coincides with attainment of peak standing crop of forage then the results approach estimates which would adhere to the SRM definition. But if utilization is measured at other times it does not. We conclude, therefore, that it does not seem practical to adhere to the SRM definition because it is not workable in most situations. Utilization should be defined for the specific situation in which it is measured, i.e. as a percentage of standing crop present at the time of measurement and the criteria for interpretation should be specified.

What is measured and how is it measured?

When utilization data are reported, specification of what

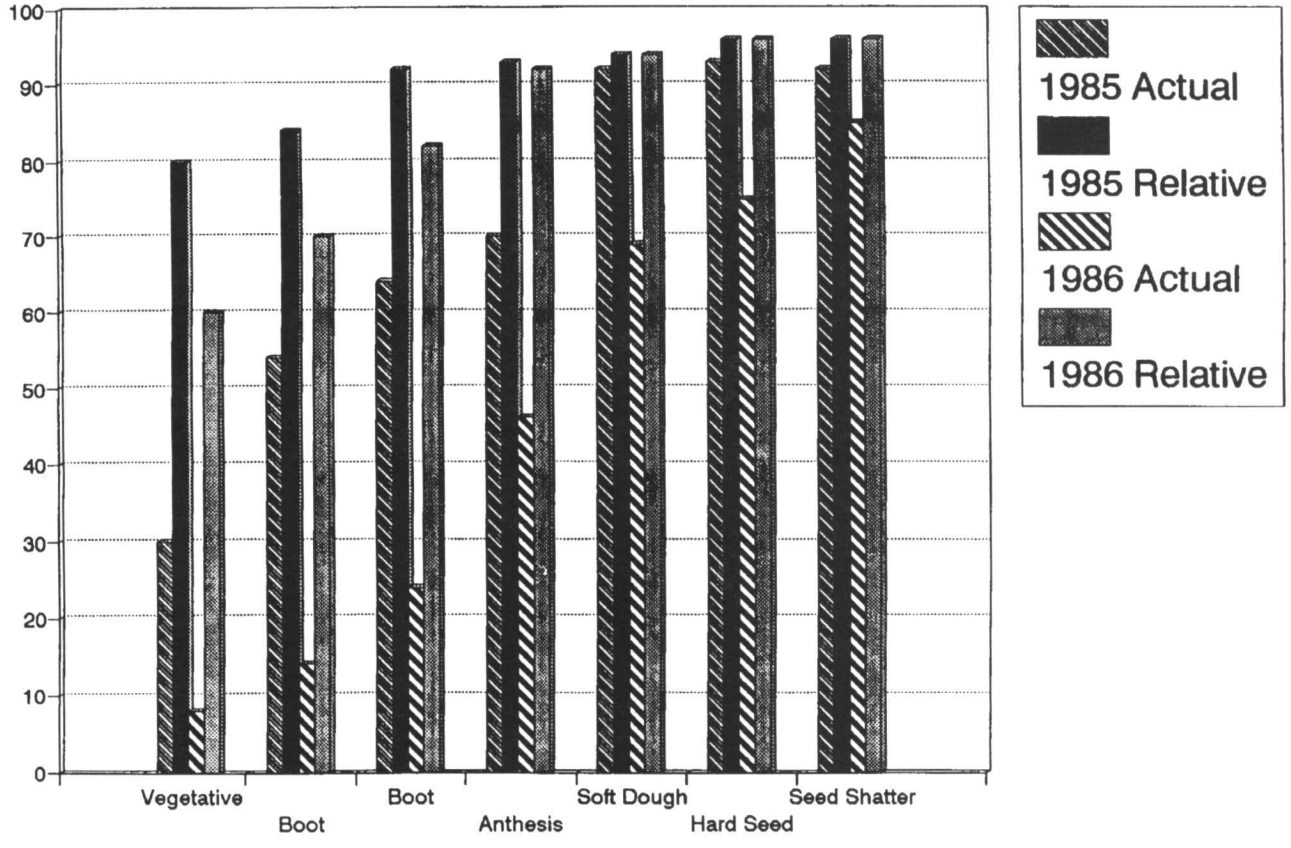

Fig. 1. *Actual and relative utilization as calculated from data of Ganskopp (1988).*

was measured and how data were collected is needed to interpret use of the data for specific management decisions. Utilization estimates usually do not include production of plants which are considered to be unpalatable or unavailable to the grazing animals in question. Estimates may only be made on one or several key species on the assumption that proper levels of use on these species will ensure that most other species are not overused. In these situations estimates may not relate well to biomass left to protect the soil or provide cover for wildlife.

Utilization may be inventoried over an entire pasture or management unit, allowing the pattern of use to be mapped, or it may be monitored only in key areas. The key area approach assumes that use in the key area is proportional to use in the unit as a whole, in much the same way as use on a key species is assumed to be proportional to use on all other species. The validity of such assumptions should be evaluated for proper interpretation of data.

What is Proper Utilization?

Proper use has been defined as the level of utilization (percent weight removed) which will be achieved when the range as a whole is properly grazed. Proper use on the key species is considered to be the level of use which will not harm the plants of that population. The rule of thumb has been to take half and leave half. This rule was established as a result mainly of clipping studies, such as the classic Crider (1955) study, which generally established that in excess of 40-60% removal of the aboveground portion of the plant reduced growth of roots and regrowth of tops and sometimes subsequent seed production.

One of the problems of the 50% use concept is that it does not take into account the way animals graze. The implication is that if every forage plant were grazed to 50% none of them would be harmed, and the most efficient possible use of the forage would result. To work, this model would require that all plants are grazed in increments, and the use on all plants would increase as AUM's removed from the pasture increases due to more animals, longer time or both. The widespread phenomenon of patch grazing and wolf plants show that this model is incorrect to some extent. The fact that more than 50% of the weight of some plants may be removed by a single bite of an animal means that some plants may be "overgrazed" regardless of the average utilization. Utilization of 50% on a key species may be achieved by 50% use on all the plants in the population or by 100% use on half the plants and none on the rest. Both situations represent take half and leave half, but only one of them has any relevance to the clipping studies that produced the rule in the first place. The rule of thumb has endured because it apparently has seemed to agree

with observations from the field. Perhaps when the general level of 50% is reached, enough plants have been grazed and regrazed to show loss in vigor for future production of the plant population.

Another problem of the 50% (or any other percentage) guideline is that the basic assumption is that undesirable vegetation changes, e.g. decline in the key species, is caused by the level of utilization on individual plants in any given year. In fact, the tolerable level of utilization on a plant is highly dependent on season of use, length of rest following use, and especially on weather conditions before, during and after use occurs. It is also highly likely that the increase or decrease of key species populations as a result of grazing is as much or more related to recruitment of new plants as to direct effects on existing plants.

It generally is accepted that season of the year and stage of growth has an important influence on how grazing affects a plant. Once an annual plant dies it can be completely consumed by grazing animals with no effect on the population provided sufficient seed remain. Herbaceous perennials likewise should be relatively unaffected by level of utilization of dead aboveground parts. In both cases, the amount of residue left may be important because of its effects on microclimate. Most of the clipping studies to determine "proper use" levels have been done in the growing season and have based results on direct physiological effects on the plants. Few studies have looked at physiological effects of dormant season use on perennial grasses or on minimum acceptable levels of residue for soil or plant protection.

Ganskopp (1988) presented data on Thurber needlegrass in Oregon which we used to calculate utilization and relative utilization. He clipped all plants to 1 in. stubble height in the fall before the treatment year to remove litter. In the following growing season plants were clipped to 1 in. height once during the growing season at various phenological stages. All plants were clipped again in fall to measure regrowth. The next spring after treatment, plants were clipped to ground level to measure spring growth and roots were excavated and weighed. The treatments were repeated in 1985 and 1986. Ganskopp concluded that defoliation in the boot stage had the most impact on total season production, regrowth the following spring, and root growth. He observed that effects were less severe in 1986 than 1985 because plants made less growth early in the 1986 season and more later due to cooler temperatures.

Our calculations of utilization and relative utilization (Figure 1) demonstrate the difference in these expressions when utilization occurs early in the season. The percentages of both were considerably influenced by differing growth patterns in the 2 treatment years. This study demonstrates that "proper use" is an elusive concept. Suppose we set a target of 50% "utilization" for management of this species. If "utilization" were based on relative utilization, it would have exceeded the target at every phenological stage in both years. Yet the level of clipping applied had little effect on subsequent vigor of the plant on many of these dates. If we used "utilization" as defined by SRM as the measure for growing season use, the target of 50% still provides no useful guide to effects on the plants. In 1985, the only dates meeting the 50% criteria were the ones where clipping was most detrimental (vegetative and boot stages). In 1986, when early growth was slower and late season regrowth greater, utilization was far below 50% when the most severe clipping treatments occurred. Late season utilization in both years greatly exceeded the 50% target in both years, yet had little effect in subsequent growth or root production. We conclude that timing of utilization is more important than intensity of use from a plant vigor standpoint. Using utilization percentages as targets for management, irrespective of plant phenology, in allotment plans or other management guidelines is not appropriate.

Andrade (1979) clipped sideoats grama plants growing on the Santa Rita Experimental Range in southern Arizona. He clipped mature plants to an 3 in. stubble height in winter, spring, summer and spring plus reclipping in summer. The 3 in. stubble height was chosen to represent approximately 70% removal by weight at peak standing crop in late summer/early fall. The summer and spring plus summer clipping treatments reduced root weight and dry weight of stem bases of plants sampled in October as compared to control plants. This effect was carried over to reduced spring herbage growth for plants clipped in the summer and spring and summer as compared to control plants. Plants clipped to 3 in. stubble height in winter or spring did not show differences from control plants for root or herbage yield. All plants clipped to 3 in. stubble height recovered to level of control plants for root weight and herbage production following a summer rest period the year following clipping.

The concept of desired or allowable use is even less clear with shrubs, which have perennial parts and buds aboveground. A major question with shrubs may be not the percent use of currents year's growth but the amount and timing of use of buds. These effects could vary drastically depending on the time of bud formation, and whether the plant has preformed buds (Dahl and Hyder, 1977). It would appear that the season of use could be even more critical for desired levels of use on shrubs than on grasses.

Commonly, use standards are set which depend on range condition, saying that 40% use is allowable on good condition range, but only 20% on poor condition range. "Proper use" on a key species should allow the population to maintain itself or increase. If desirable plants are scarce on a poor condition range, as one would expect, then proper stocking rate may be lower than on a good condition range because there is less forage available. But there is no reason to believe that individual plants are less able to withstand a given level of utilization on a poor range than on a good one. On the contrary, they might even stand higher levels of grazing since they may have less competi-

tion from their neighbors. Adjusting season of use to provide for recruitment of desirable species is likely a more realistic management strategy than setting very light utilization guidelines.

Conclusions

Based on the information reviewed we conclude that:

The SRM definition of utilization is not practical as utilization is rarely expressed or measurable as defined.

Utilization guidelines must be tailored for specific situation, i.e. time of use, what is measured, and how use is measured.

The timing of grazing is much more important than the percentage of biomass removed.

That a new term, such as relative utilization, be used to express utilization as it is currently being measured and the information is being used. Relative use guidelines can be developed and tailored to specific situations which are reliable indices for making management decisions.

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