IV. ATTRIBUTES

Excerpt from: Sampling Vegetation Attributes- Interagency Technical Reference (BLM/RS/ST-96/002+1730)

The following is a matrix of monitoring techniques and vegetation attributes that are described in this reference. The X indicates that this is the primary attribute that the technique collects. Some techniques have the capability of collecting other attributes; the • indicates the secondary attribute that can be collected or calculated.

Method	Frequency	Cover	Density	Production	Structure	Composition
Frequency	X	•				
Dry-weight-Rank	•			•		X[3]
Daubenmire	•	X				•
Line Intercept		X				•
Step Point		X				•
Point Intercept		X				•
Density			X			•
Double Weight Sampling				X		•
Harvest				X		•
Comparative Yield				X		•
Cover Board		X			X	
Robel Pole				•	X	

A. Frequency

1. *Description*

Frequency is one of the easiest and fastest methods available for monitoring vegetation. It describes the abundance and distribution of species and is useful to detect changes in a plant community over time.

Frequency has been used to determine rangeland condition but only limited work has been done in most communities. This makes the interpretation difficult. The literature has discussed the relationship between density and frequency but this relationship is only consistent with randomly distributed plants (Greig-Smith 1983).

[3] Species composition is calculated using production data. Frequency data should not be used to calculate species composition.

Frequency is the number of times a species is present in a given number of sampling units. It is usually expressed as a percentage.

2. *Advantages and Limitations*

a Frequency is highly influenced by the size and shape of the quadrats used. Quadrats or nested quadrats are the most common measurement used; however, point sampling and step point methods have also been used to estimate frequency. The size and shape of a quadrat needed to adequately determine frequency depends on the distribution, number, and size of the plant species.

b To determine change, the frequency of a species must generally be at least 20% and no greater than 80%. Frequency comparisons must be made with quadrats of the same size and shape. While change can be detected with frequency, the extent to which the vegetation community has changed cannot be determined.

c High repeatability is obtainable.

d Frequency is highly sensitive to changes resulting from seedling establishment. Seedlings present one year may not be persistent the following year. This situation is problematic if data is collected only every few years. It is less of a problem if seedlings are recorded separately.

e Frequency is also very sensitive to changes in pattern of distribution in the sampled area.

f Rooted frequency data is less sensitive to fluctuations in climatic and biotic influences.

g Interpretation of changes in frequency is difficult because of the inability to determine the vegetation attribute that changed. Frequency cannot tell which of three parameters has changed: canopy cover, density, or pattern of distribution.

3. *Appropriate Use of Frequency for Rangeland Monitoring* If the primary reason for collecting frequency data is to demonstrate that a change in vegetation has occurred, then on most sites the frequency method is capable of accomplishing the task with statistical evidence more rapidly and at less cost than any other method that is currently available (Hironaka 1985).

Frequency should not be the only data collected if time and money are available. Additional information on ground cover, plant cover, and other vegetation and site data would contribute to a better understanding of the changes that have occurred (Hironaka 1985).

West (1985) noted the following limitations: "Because of the greater risk of misjudging a downward than upward trend, frequency may provide the easiest early warning of undesirable changes in key or indicator species. However, because frequency data are so dependent on quadrat size and sensitive to non-random dispersion patterns that prevail on rangelands, managers are fooling themselves if they calculate percentage composition from frequency data and try to compare different sites at the same time or the same site over time in terms of total species composition. This is because the numbers derived for frequency sampling are unique to the choice of sample size, shape, number, and placement. For variables of cover and weight, accuracy is mostly what is affected by these choices and the variable can be conceived independently of the sampling protocol."

B. Cover

1. Description Cover is an important vegetation and hydrologic characteristic. It can be used in various ways to determine the contribution of each species to a plant community. Cover is also important in determining the proper hydrologic function of a site. This characteristic is very sensitive to biotic and edaphic forces. For watershed stability, some have tried to use a standard soil cover, but research has shown each edaphic site has its own potential cover.

Cover is generally referred to as the percentage of ground surface covered by vegetation. However, numerous definitions exist. It can be expressed in absolute terms (square meters/hectares) but is most often expressed as a percentage. The objective being measured will determine the definition and type of cover measured.

a Vegetation cover is the total cover of vegetation on a site.

b Foliar cover is the area of ground covered by the vertical projection of the aerial portions of the plants. Small openings in the canopy and intraspecific overlap are excluded (Figure 6).

c Canopy cover is the area of ground covered by the vertical projection of the outermost perimeter of the natural spread of foliage of plants. Small openings within the canopy are included. It may exceed 100% (Figure 7).

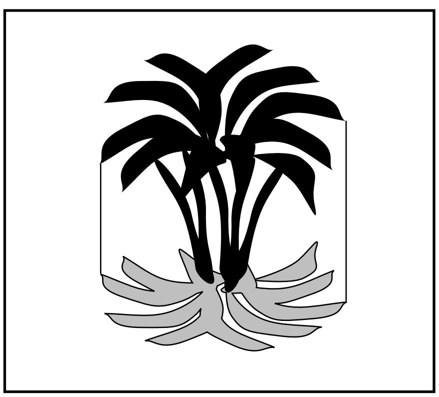

Figure 6. Foliar cover.

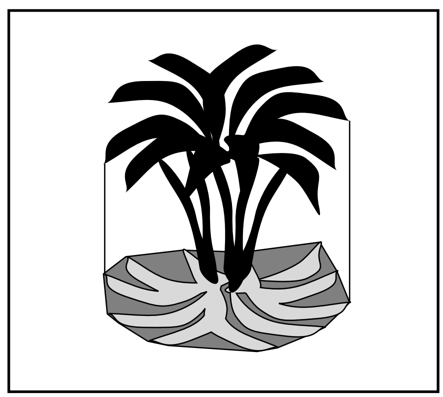

Figure 7. Canopy cover.

d Basal cover is the area of ground surface occupied by the basal portion of the plants.

e Ground cover is the cover of plants, litter, rocks, and gravel on a site.

2. *Advantages and Limitations*

a Ground cover is most often used to determine the watershed stability of the site, but comparisons between sites are difficult to interpret because of the different potentials associated with each ecological site.

b Vegetation cover is a component of ground cover and is often sensitive to climatic fluctuations that can cause errors in interpretation. Canopy cover and foliar cover are components of vegetation cover and are the most sensitive to climatic and biotic factors. This is particularly true with herbaceous vegetation.

c Overlapping canopy cover often creates problems, particularly in mixed communities. If species composition is to be determined, the canopy of each species is counted regardless of any overlap with other species. If watershed characteristics are the objective, only the uppermost canopy is generally counted.

d For trend comparisons in herbaceous plant communities, basal cover is generally considered to be the most stable. It does not vary as much due to climatic fluctuations or current-year grazing.

C. Density

1. *Description* Density has been used to describe characteristics of plant communities. However, comparisons can only be based on similar life-form and size. This is why density is rarely used as a measurement by itself when describing plant communities. For example, the importance of a particular species to a community is very different if there are 1,000 annual plants per acre versus 1,000 shrubs per acre. It should be pointed out that density was synonymous with cover in the earlier literature.

Density is basically the number of individuals per unit area. The term refers to the closeness of individual plants to one another.

2. *Advantages and Limitations*

a Density is useful in monitoring threatened and endangered species or other special status plants because it samples the number of individuals per unit area.

b Density is useful when comparing similar life-forms (annuals to annuals, shrubs to shrubs) that are approximately the same size. For trend measurements, this parameter is used to determine if the number of individuals of a specific species is increasing or decreasing.

c The problem with using density is being able to identify individuals and comparing individuals of different sizes. It is often hard to identify individuals of plants that are capable of vegetative reproduction (e.g., rhizomatous plants like western wheatgrass or Gambles oak). Comparisons of bunchgrass plants to rhizomatous plants are often meaningless because of these problems. Similar problems occur when looking at the density of shrubs of different growth forms or comparing seedlings to mature plants. Density on rhizomatous or stoloniferous plants is determined by counting the number of stems instead of the number of individuals. Seedling density is directly related to environmental conditions and can often be interpreted erroneously as a positive or negative trend measurement. Because of these limitations, density has generally been used with shrubs and not herbaceous vegetation. Seedlings and mature plants should be recorded separately.

If the individuals can be identified, density measurements are repeatable over time because there is small observer error. The type of vegetation and distribution will dictate the technique used to obtain the density measurements. In homogenous plant communities, which are rare, square quadrats have been recommended, while heterogenous communities should be sampled with rectangular or line strip quadrats. Plotless methods have also been developed for widely dispersed plants.

D. Production

1. *Description* Many believe that the relative production of different species in a plant community is the best measure of these species' roles in the ecosystem.

The terminology associated with vegetation biomass is normally related to production.

a Gross primary production is the total amount of organic material produced, both above ground and below ground.

b Biomass is the total weight of living organisms in the ecosystem, including plants and animals.

c Standing crop is the amount of plant biomass present above ground at any given point.

d Peak standing crop is the greatest amount of plant biomass above ground present during a given year.

e Total forage is the total herbaceous and woody palatable plant biomass available to herbivores.

f Allocated forage is the difference of desired amount of residual material subtracted from the total forage.

g Browse is the portion of woody plant biomass accessible to herbivores.

2. *Advantages and Limitations*

a Biomass and gross primary production are rarely used in rangeland trend studies because it is impractical to obtain the measurements below ground. In addition, the animal portion of biomass is rarely obtainable.

b Standing crop and peak standing crop are the measurements most often used in trend studies. Peak standing crop is generally measured at the end of the growing season. However, different species reach their peak standing crop at different times. This can be a significant problem in mixed plant communities.

c Often, the greater the diversity of plant species or growth patterns, the larger the error if only one measurement is made.

d Other problems associated with the use of plant biomass are that fluctuations in climate and biotic influences can alter the estimates. When dealing with large ungulates, exclosures are generally required to measure this parameter. Several authors have suggested that approximately 25% of the peak standing crop is consumed by insects or trampled; this is rarely discussed in most trend studies.

e Collecting production data also tends to be time and labor intensive. Cover and frequency have been used to estimate plant biomass in some species.

E. Structure

1. *Description* Structure of vegetation primarily looks at how the vegetation is arranged in a three-dimensional space. The primary use for structure measurements is to help evaluate a vegetation community's value in providing habitat for associated wildlife species.

   Vegetation is measured in layers on vertical planes. Measurements generally look at the vertical distribution by either estimating the cover of each layer or by measuring the height of the vegetation.

2. *Advantages and Limitations* Structure data provide information that is useful in describing the suitability of the sites for screening and escape cover, which are important for wildlife. Methods used to collect these data are quick, allowing for numerous samples to be obtained over relatively large areas. Methods that use visual obstruction techniques to evaluate vegetation height have little observer bias. Those techniques that estimate cover require more training to reduce observer bias. Structure is rarely used by itself when describing trend.

F. Composition

1. *Description* Composition is a calculated attribute rather than one that is directly collected in the field. It is the proportion of various plant species in relation to the total of a given area. It may be expressed in terms of relative cover, relative density, relative weight, etc.

   Composition has been used extensively to describe ecological sites and to evaluate rangeland condition.

   To calculate composition, the individual value (weight, density, percent cover) for a species or group of species is divided by the total value of the entire population.

2. *Advantages and Limitations*

a Quadrats, point sampling, and step point methods can all be used to calculate composition.

b The repeatability of determining composition depends on the attribute collected and the method used.

c Sensitivity to change is dependent on the attribute used to calculate composition. For instance, if plant biomass is used to calculate composition, the values can vary with climatic conditions and the timing of climatic events (precipitation, frost-free period, etc.). Composition based on basal cover, on the other hand, would be relatively stable.

d Composition allows the comparison of vegetation communities at various locations within the same ecological sites.