COLORADO RANGELAND MONITORING GUIDE

This is the Official
Rangeland Monitoring Guide
for the

Colorado Resource Monitoring Initiative

This guidebook and the Colorado Resource Monitoring Initiative are endorsed by:

Colorado Association of Conservation Districts

Colorado State University Extension

COLORADO CATTLEMEN'S ASSOCIATION

NRCS

Revised: January, 2014

ACKNOWLEDGEMENTS

We wish to acknowledge the Wyoming Range Service Team, whose mission and purpose is to promote cooperation and coordination between agencies represented on the Team, and to further communication among the Team and other rangeland management partners. The Colorado Rangeland Monitoring Guide is based in large part on the Wyoming Rangeland Monitoring Guide, with permission of the Wyoming Team. This guide, however, has been revised for adaptation and use in Colorado in recognition that ecological agencies, circumstances and needs differ among states. We thank the Wyoming Team for permission to use their excellent guide as a template for our Colorado guide.

Along with the Wyoming Team, Colorado organized its own stakeholder group that was integral in adapting this guidebook for use in Colorado. The stakeholder group was comprised of private landowners, public land managers, and state and federal agency personnel. The underlying objective of the stakeholder group was to develop a standardized approach to rangeland monitoring that would lead to increased implementation of monitoring on Colorado's private, state, and federal lands. This developed, standardized approach is referred to as the Colorado Resource Monitoring Initiative (CRMI). The efforts and goals of the stakeholder group are illustrated in this guidebook. Thus, much effort went into making sure that this guidebook and CRMI outline monitoring in a way that is simplistic, functional and credible for all who use it.

Again, we would like to thank the following CRMI stakeholders for their time, input, and expertise in the development of a standardized approach to rangeland monitoring:

- Bureau of Land Management
- Colorado Association of Conservation Districts
- Colorado Cattlemen's Association
- Colorado Department of Agriculture
- Colorado Division of Wildlife
- Colorado Grazing Lands Conservation Initiative
- Colorado Public Lands Council
- Colorado Section of the Society for Range Management
- Colorado State Land Board
- Colorado State University Extension
- Natural Resources Conservation Service
- USDA Forest Service

Many of our valuable partners have had the opportunity to review and support this guide. Many of those individuals and organizations are a significant part of the sustainable management of Colorado's rangelands and resources. Thank you for your interest, and we hope this guide serves you well.

TABLE OF CONTENTS

INTRODUCTION

Before introducing the definitions of rangeland monitoring, short- and long-term monitoring, etc.; it is important to first understand the importance and benefits of monitoring to management and rangeland and resource health.

WHY MONITOR?

Reasons to monitor rangelands include:

- Determine whether management objectives are realistic and achievable;
- Evaluate when management strategy changes are needed to better meet identified objectives;
- Provide a record of environmental and resource conditions, events and management practices that may influence rangeland vegetation;
- Determine whether the grazing management strategy meets the objectives established for resource conditions and livestock on the unit/allotment/pasture;
- Provide information to guide management of livestock (i.e., determining when to move livestock); and
- Determine whether livestock grazing and other management plans are being followed, and track how they were modified in practice.

GOALS, OBJECTIVES AND DESIRED OUTCOMES

It is commonly said among the rangeland community that one should never monitor for the sake of monitoring. Thus, before beginning any monitoring on allotments or pastures, first carefully define your goals and objectives. Goals are broad categories of desired accomplishments. Write them out. This accomplishes two things. First, it provides an opportunity for you to think about your management and the health of the rangelands; second, it serves as a periodic reminder to you as you contemplate your management efforts and results from year to year. The best monitoring requires organized recordkeeping. Having information organized through time is helpful so you can find and use it when needed; and you can also really evaluate whether objectives and goals are being met. When working with land management agencies, keep in mind that they will often have broader or different goals, objectives and desired conditions than you may have. Most often, it is possible to mesh your goals and objectives with those of the agencies. It simply takes communication, and it must happen if all involved parties are striving for the same desired conditions on-the-ground.

> ***When the procedures in this guidebook are applied by a trained individual and are followed as shown, the information gathered is normally acceptable to State and Federal cooperating agencies. Whenever possible, coordinate public lands***

monitoring with the appropriate public land manager, and jointly collect the information. The information collected will contribute to evaluating whether rangelands are meeting short-term standards and design criteria, as well as long-term goals, objectives and desired conditions.

We recommend a combination of short-term and long-term monitoring. Long-term monitoring is designed to document changes in the condition of the land, such as changes in soil structure and plant basal cover, and is normally repeated every one to five years. Short-term monitoring may be repeated at any time interval, and is designed to check whether or not the management system is being followed (how much residual cover remains, or how much biomass is removed). Long-term monitoring is used to generate a "trend record," while short-term monitoring is used to establish an "annual-use record."

DEFINING RANGELAND MONITORING

Rangeland monitoring is the orderly, repeated collection, analysis and interpretation of resource information (data). The data can be used to guide both short- and long-term adaptive management decisions. This guidebook is designed to provide individuals interested in monitoring rangelands with information and processes useful for simple, quick and efficient monitoring. To start with, this guidebook will introduce the concepts of short- and long-term monitoring. The following flow chart illustrates how short- and long-term monitoring are implemented in order to collect information that will aid in management decisions.

MONITORING, MANAGEMENT, AND DATA ANALYSIS FLOW CHART

Establish Your Baseline Information
"Long-Term Monitoring"

Define management and monitoring objectives

↓

Select monitoring sites and indicators

↓

Year 1 of Monitoring: Establish and describe monitoring sites and record long-term monitoring data (baseline information/trend data)

↓

Long-term monitoring is typically repeated on a 5-year basis, but determine how often to repeat long-term monitoring with your respective rangeland specialist(s).

↓

Collect Annual Event Information
"Short-Term Monitoring"

Record annual management practices and/or other impacts that affect rangeland health from year to year

(i.e. climate and precipitation, livestock turn-out dates, wildlife, etc.)

↓

Adjust management practices on an as-needed basis

↓

Short-term monitoring is repeated on an annual basis and is utilized to help you identify if management adjustments need to be made; such as more livestock, shorten grazing period, etc.

↓

Data Analysis & Record Keeping

Repeat long-term monitoring data and compare that with your baseline data, which would be your initial long-term monitoring record. Also, compare your short-term monitoring data with your baseline information in order to interpret changes in management for the benefit of your natural resource and your overall operation.

Record both long- and short-term monitoring data in a permanent and secure location,

such as a commercially available database, spreadsheet, etc.

Using the comparable date, refine your management strategies (i.e. change season of use,

grazing duration, fencing, etc.)

LONG-TERM MONITORING

Long-term (or Effectiveness) monitoring is the measurement of progress toward meeting objectives and desired conditions, such as changes in plant community composition, cover and structure, or soil resource conditions over time. It is critical to detect changes in the rangeland early and often enough to make necessary adaptive adjustments in grazing management strategy or other management practices. Long-term rangeland condition and trend information is necessary to make these adjustments. While we suggest that the primary responsibility for long-term monitoring on public lands lies with the land management agencies, operators should be closely involved so they can assist in data collection that will supplement agency information. In addition, if private landowners are currently monitoring on their public allotment(s)/pasture(s), it would also be beneficial to conduct long-term monitoring on their private lands.

The procedures described in this guidebook can provide simple and credible long-term monitoring data that can be collected by any trained individual. In addition, the producer should be aware of the various cover, frequency and other methods that have been extensively used by agencies when monitoring on public lands. Complete descriptions of these and other methods can be found in resources such as the Colorado Rangeland Monitoring Handbook (and in various other agency guides) and may be used by producers who wish to supplement or add to data that may or may not be acquired on their allotments or benchmark areas.

SHORT-TERM MONITORING

It is critical to record annual management practices and impacts such as calendar dates for livestock use periods, weather (timing and quantities of precipitation), grazing use-intensity, pasture rotations, actual livestock use, wildlife use and recreation impacts. These factors are examples of short-term monitoring. Short-term monitoring is helpful in explaining changes measured during long-term monitoring (which will be explained next). It is difficult to make effective changes in grazing management strategies without a record of annual conditions, events or management practices that have an influence on rangeland conditions. Short-term monitoring also helps the producer determine when, where and how to move livestock so that the long-term effects will be positive.

Often, many of the short-term monitoring processes will consist of the following two closely-related, but distinct concepts and processes which are 1) trigger (or within-season) monitoring and 2) end-point indicator monitoring. These two processes are discussed here because of their importance to stubble height, but can also be effectively used with other short-term monitoring methods.

Trigger Monitoring

An action is 'triggered" when the indicator (such as stubble height) reaches a predetermined point. Frequently, the action is to move livestock from one pasture to the

next. Trigger monitoring normally occurs on one or more key species (or groups of similar species) in a key area. When the actual utilization or residual vegetation (e.g., stubble height) approaches the allowable use criteria, livestock are removed from the pasture.

Allowable use criteria for key areas are designed to promote long-term maintenance or recovery of vegetative, stream or other resources. In addition, meeting "trigger" stubble height guidelines should also facilitate meeting endpoint indicator criteria at the end of the season.

End-Point Monitoring

Residual stubble height monitoring, or end-of-season utilization monitoring, is normally conducted on key species and key areas following the end of the grazing or the growing season (whichever occurs later). It is often a key factor in riparian management. Retention of a specified height of vegetative plant material along the Greenline (streamside monitoring) aids in trapping and retaining sediments by slowing overland water flows associated with winter and spring runoff. Similarly, retention of a desired level of standing crop of upland vegetative plant material can benefit plant health, wildlife winter range needs, bird nesting habitat, etc. As with "trigger" monitoring, the actual end-of-season utilization, or remaining residual stubble height, is compared to a defined allowable use criteria (often either an end-of-season percentage of use, or a residual stubble height; or, at times, a structure value).

WHERE AND WHEN TO MONITOR

Now that some of the basic concepts of monitoring have been reviewed, the next step is to determine where and when monitoring should be implemented and performed. Some view monitoring as a cumbersome and time-consuming process, but this doesn’t have to be the case. This section will delineate how to target monitoring practices so that both time and data collection are carried out in an effective and efficient manner.

Where to Monitor

It is not practical or necessary to monitor every rangeland acre. However, it is essential to select monitoring sites (i.e. benchmark sites, key areas) that are representative of larger management areas, or are themselves special areas of concern.

- Benchmark sites are those areas selected for long-term monitoring, as they are expected to be capable of detecting changes in management over time.
- Key areas, on the other hand, are those areas selected for short-term monitoring, and often represent the most critical, but manageable, areas in a pasture.
- Key areas and benchmark sites may occur on the same piece of ground, but typically do not.

Proper benchmark/key area selection is critical. One or more benchmark sites and one or more key areas should be established in each significant pasture or unit. It is important to locate these monitoring areas away from sites that are not representative of the larger grazeable rangelands of the management unit, such as unavoidable concentration areas near fences, salt locations, stock trails, saddles, or in unused or lightly-used areas. For factors that change across a landscape, more than one benchmark or key area may be needed. Again, it is important to emphasize that when monitoring on publics lands, monitoring activities and benchmark/key area locations should be coordinated with the appropriate agency specialist.

When to Monitor

For short-term monitoring, consider both grazing and browsing impacts by all animal species when scheduling monitoring activities. It may be necessary to conduct short-term monitoring before, during and after grazing or browsing use occurs. Record actual livestock use numbers on the Site Information Form (explained in "Monitoring Methods" section). At the conclusion of the grazing season, maintain copies of all completed forms and photos, and if appropriate, provide copies to the agency specialist for the allotment files.

For long-term monitoring, the study should generally be repeated on a five- to ten-year interval (longer for plant communities that are slow to respond to management changes; shorter for plant communities that respond rapidly, such as riparian areas).

MONITORING INDICATORS AND METHODS

The CRMI stakeholders delineated both rangeland health indicators and methods that are commonly used by producers and agencies in Colorado. These methods were selected because they are generally easy to use, require a limited amount of time and training, and tend to produce consistently reliable results when the method is properly applied by a trained person. Therefore, individuals can easily receive training through the CRMI program in order to collect monitoring information that will have a significant effect on maintaining or improving rangeland health.

Again, the methods in this guidebook represent only a few of the wide variety of monitoring tools available. A more extensive collection can be found in resources such as the Colorado Rangeland Monitoring Handbook, or in various other agency guides. Nonetheless, not all methods presented here are required or appropriate in all situations. Likewise, methods not presented may be necessary for a specific objective. Thus, choose the suite of tools that will allow determination as to whether long-term objectives (i.e. desired conditions), as well as short-term goals (i.e. management objectives) are being met and, if so, how rapidly.

This guidebook provides an easy-to-use matrix that outlines methods that can be used to measure the rangeland health indicators delineated by the CRMI stakeholders. The matrix also

outlines whether indicators are long- or short-term measurements. A list of definitions for each of the indicators follows the matrix. Also, following the matrix, each monitoring method is described in detail and includes an example of a completed form. For field use, make copies of these blank forms which are found at the end of this guide.

Monitoring Indicators and Methods Matrix: As determined by the CRMI stakeholder group

The following table is a matrix of monitoring methods and rangeland health indicators that are described in this monitoring guide. The term “primary” indicates that this is the primary indicator that the method measures/collects. Some methods have the capability of measuring other indicators outside of the primary one; therefore, the term “secondary” specifies other indicators that can also be measured/collected by the stated method.

For a list of other methodologies that were not delineated as being “primary” or “secondary” by the CRMI stakeholders, please see Appendix A. Although these methods are not the methods preferred by the CRMI stakeholders, they may be the most appropriate for your specific situation. Again, the best way to determine which methods you should use is to consult with your agency range specialist.

The column labeled “Management Observations” provides optional processes that will allow you to assess management effectiveness. Over time, this information will help you understand how your rangeland responds to your management practices. This information, coupled with rangeland health indicators, will provide you with comprehensive information that you can use to determine how best to maintain and improve your resource.

	COLORADO RESOURCE MONITORING INTIATIVE METHODS AND INDICATORS[1]							
	INDICATORS **LTM = Long-Term; STM = Short-Term**							
Basic Information	**Shaded Methods Denote *CRMI-Lite*** Methodology**							
Site Information	Each time monitoring occurs at a specific site, the Site Information, Record for Livestock Operators, and Vegetation forms should be completed and filed for your permanent records. These forms will allow you to keep track of each monitoring site when measuring rangeland health indicators over time.							
Record for Livestock Operators								
Vegetation								
METHODS	**Productivity** ***LTM & STM***	**Structure** ***LTM & STM***	**Composition** ***LTM***	**Cover -** ***Foliar*** ***LTM***	**Cover -** ***Ground*** ***LTM***	**Frequency** ***LTM***	**Utilization** ***STM***	**Management Practices** ***Annual Observations***
LONG-TERM & SHORT-TERM								
Permanent Photos and Photo Point Transects	Primary	Secondary	Secondary	Primary	Secondary		Secondary Aspect[2]	Primary
Ocular Plant Composition	Secondary	Secondary	Primary	Primary	Primary	Primary		
LONG-TERM								
Line Point Intercept			Secondary	Primary	Primary	Secondary		
Cover and Frequency			Primary	Secondary	Primary	Primary		
Line Point Intercept for Shrubs			Secondary	Primary	Primary			
Step Point				Primary	Primary	Secondary		
Cover by Life Form Transect				Primary				
Density of Key Species			Primary					
Other agreed upon methodology depending on situation and goals*								
SHORT-TERM								
Grazing Response Index	Primary						Primary	
Landscape Appearance								Primary
Grazed Class Method for Forage Plant Utilization							Primary	
Grazing Use Map							Primary	Primary
Stubble Height								Primary
Other agreed upon methodology depending on situation and goals*								

[1] Each method and indicator is noted as being either a long- or short-term measurement of rangeland health

[2] Aspect means that the photo needs to be taken at the same location and in the same direction in order to analyze rangeland trends year over year

*Other methods can be used as long as agreed upon by agency and permitee/lessee

**CRMI-Lite provides basic monitoring needs. It does not capture all qualitative and quantitative aspects which may be needed, such as found in the CRMI Assurance Package. Please consult with all cooperators before implementing CRMI-Lite.

MATRIX INDICATOR DEFINITIONS

Composition – *Long-Term*: The proportions (percentages) of various plant species in relation to the total on a given area. It may be expressed in terms of relative cover, relative density, relative weight, etc.

Cover (*Foliar*) – *Long-Term*: The percentage of ground covered by a downward vertical projection of the aerial portion of plant foliage, excluding small openings in the canopy. Foliar cover is always less the canopy cover. Total foliar cover of all species may exceed 100 percent because plants grow in layers.

Cover (*Ground*) – *Long-Term*: The percentage of material, other than bare ground, covering the land surface. It may include live and standing dead vegetation, litter cobble, gravel, stones, and bedrock. Ground cover plus bare ground would total 100 percent.

Frequency (*% Occurrence by Species*) – *Long-Term*: A quantitative expression of the presence or absence of individuals of a species in a population. It is defined as the percentage of occurrence of a species in a series of samples of uniform size.

Productivity – *Long-Term & Short-Term*: The rate of production per unit area over a specific period of time, usually expressed in terms of weight or energy.

Structure – *Long-Term & Short-Term*: The vertical and horizontal distribution of vegetation in an area (how the vegetation is arranged in a 3-D space). Measurements generally look at the vertical distribution by either estimating the cover of each layer or by measuring the height of the vegetation.

Utilization – *Short-Term*: The proportion or degree of the current year's forage production that is consumed or destroyed by animals (including insects). The term may refer either to a single plant species, a group of species, or to the vegetation community as a whole. Utilization is synonymous with use.

MONITORING METHODS – IMPLEMENTATION PROTOCOLS

BASIC INFORMATION

When monitoring, there are some basic information forms that need to be completed for virtually all monitoring activities and methods. These include the Site Information, Record for Livestock Operators, and Vegetation Forms. Each of these forms are explained in detail below along with additional information you may want to record such as a site location map (displays where each monitoring site is located) or a photo information sheet (identifies when and where a photo was taken).

Site Information

A "Site Information Form" should be completed whenever and wherever any of the methods described in this guide are used. It may also be necessary to update key parts of the form if anything changes from one monitoring period to another. The information described here is basic and should not require significant scrutiny by the observer.

The "Site Information Form" should include the following:

Site Information

Unit Name: Record the name of the allotment, management area or another geographic description of the unit to be monitored.

Pasture Name: Record the name of the pasture or sub-unit to be monitored.

Study Site: Record the number or name of the specific site where monitoring data or photographs are collected.

Date: Record the date the information is collected.

Observer: Record the name of the individual(s) collecting the monitoring information.

Monitoring Method(s): List the method(s) by which monitoring information is collected.

Date Study Established: Record the date the first information was collected for this site. This facilitates tracking trend information across multiple years.

Study Location: Record the legal description of where the study site is located and how it is marked. Be as specific as possible (use GPS when possible), so that others can easily relocate the site in later years.

Access (Optional): Describe the best way to get to the study site.

Ownership (Optional): Record the land ownership (and management responsibility) for the monitoring site.

Site Characteristics

Landform (Optional): Record the best landform description of the general area where the plot is located.

Elevation (Optional): Record the elevation of the study site to the nearest 100 feet.

Slope Percentage (Optional): Record the average slope percentage of the general terrain where the study site is located.

Average Annual Precipitation (Optional): Record the approximate average, long-term annual precipitation to the nearest inch for the growing season and grazing season. Do not record the current year's precipitation.

Range Site: Specify whether the study site is representative of upland/wetland or riparian conditions.

Current Growing Conditions: Indicate whether this year's conditions are above, near or below average for a typical year (in terms of moisture amounts and timing and seasonal temperatures). Record moisture amounts for the growing season and grazing season.

Exposure (Aspect) (Optional): Indicate the general aspect (direction the slope faces) on which the study site is located.

Soil (Optional): Indicate the general soil characteristics of the study site. Note: More than one soil texture can be checked. For example, if the soil is a sandy loam, then check both Sand and Loam.

Other Climatic Information (Optional): Record any applicable remarks regarding the climatic conditions, especially those out-of-the-ordinary for the current year, or for recent past years.

Unit/Pasture Use Information

Kind and Class of Animal: Identify the kind (cattle, sheep, bison, horse, etc.) and class (cow/calf, yearling etc.) of livestock grazing the unit and pasture this grazing year.

Season of Use: Record the actual on and off dates for the pasture.

Number: Record the number of livestock animals grazing the unit this year.

Grazing System: Record the type of grazing system used in the allotment or management area.

Current Year Grazing Management: Describe the pasture rotation for this year, especially for this particular pasture.

Other Notes (Optional): Record any other pertinent information about the grazing system, range readiness, current plant physiology, (timing of flowering, seed set, maturation, dormancy, etc.) or other information worth capturing for future reference.

SAMPLE

SITE INFORMATION FORM

Complete this form when conducting any of the study methods in this booklet to provide an important summary of site information. If no study methods are conducted, completing this form alone will still provide a record of valuable information. **All fields are required unless otherwise indicated to be optional "opt." Complete the blanks to the best of your knowledge.**

■ Initial Reading ☐ Annual Reading

Unit Name Lake Creek Pasture Name Baldy

Study Site (# or name) Billy Creek Date 6/20/2001 Observer R. Jones

Monitoring Method(s) Landscape Appearance Date Study Established 6/20/2001

Study Located ☐ N ☐ S ☐ E ■ W of Trail Crossing on Lake Creek, 200 ft.

N/W 1/4 of SW 1/4 of Section 16 Township 14N Range 26 E

Access (opt.) Hwy. 66 to County Road 241

Ownership (opt.) B. Robertson GPS Coordinates Lat. N 35° 1' 47.9869" Long. W 135° 10' 32.8125"

Site Characteristics

Landform (opt.) Mountain Meadow

Elevation (opt.) 5,300 ft. % Slope (opt.) 1 Average Annual Precipitation (opt.) 16"

Range Site	Current Growing Conditions	Exposure (opt.)	Soil (opt.)
■ Upland (U)	☐ Above Average (1)	☐ N ☐ S	■ Sand (1)
☐ Riparian (R)	☐ Average (2)	■ NE ☐ SW	☐ Silt (2)
	■ Below Average (3)	☐ E ☐ W	☐ Clay (3)
		☐ SE ☐ NW	■ Loam (4)

Other Climatic Information (opt. snow depth/persistence, temperatures, storms/flooding, etc.)

Temperatures during May were cooler than normal.

Unit/Pasture Use Information

Kind & Class of Animal Cow/Calf Season of Use 6/01 to 7/01

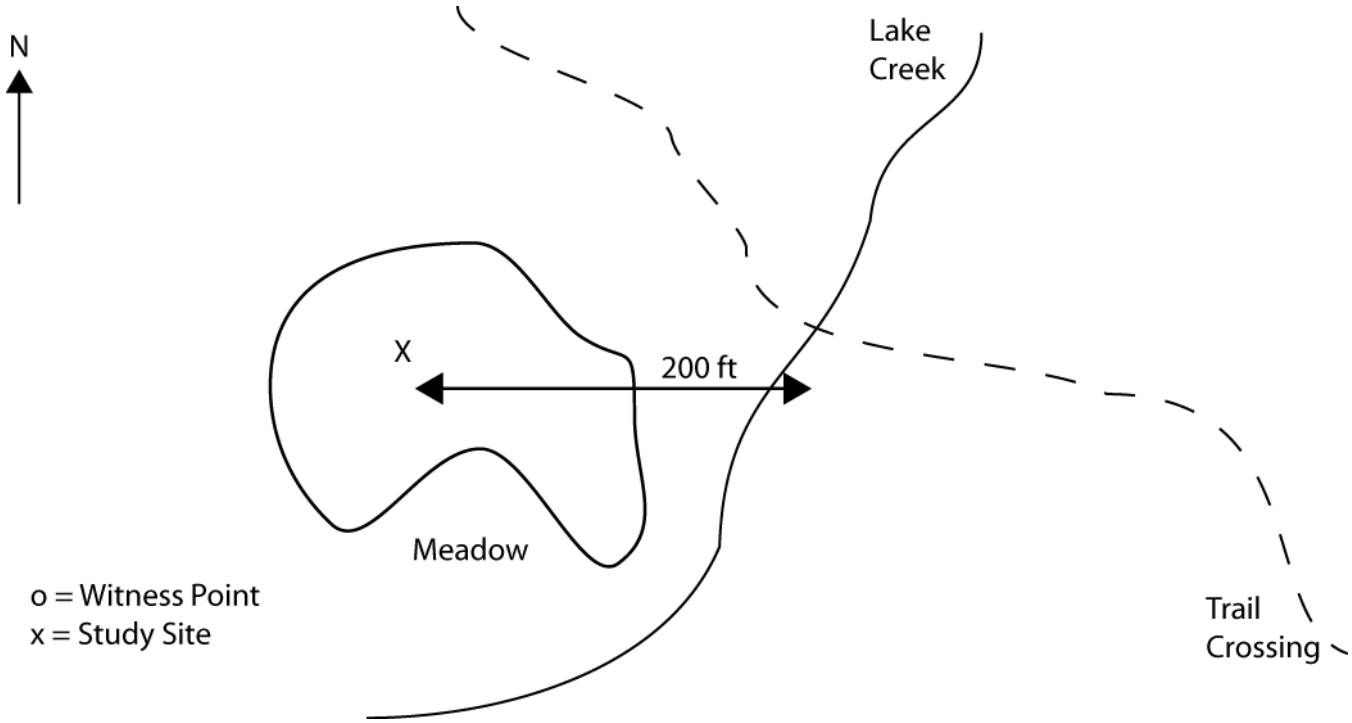
Number 175 Grazing System Rest Rotation

Current Year Grazing Management Baldy to Iron Creek - Rest Willow Creek

Other Notes (opt. for example, growth stage of plants at time of use) Counted 22 head of elk in pasture when cattle went on. Use levels in riparian area were light to moderate.

SAMPLE

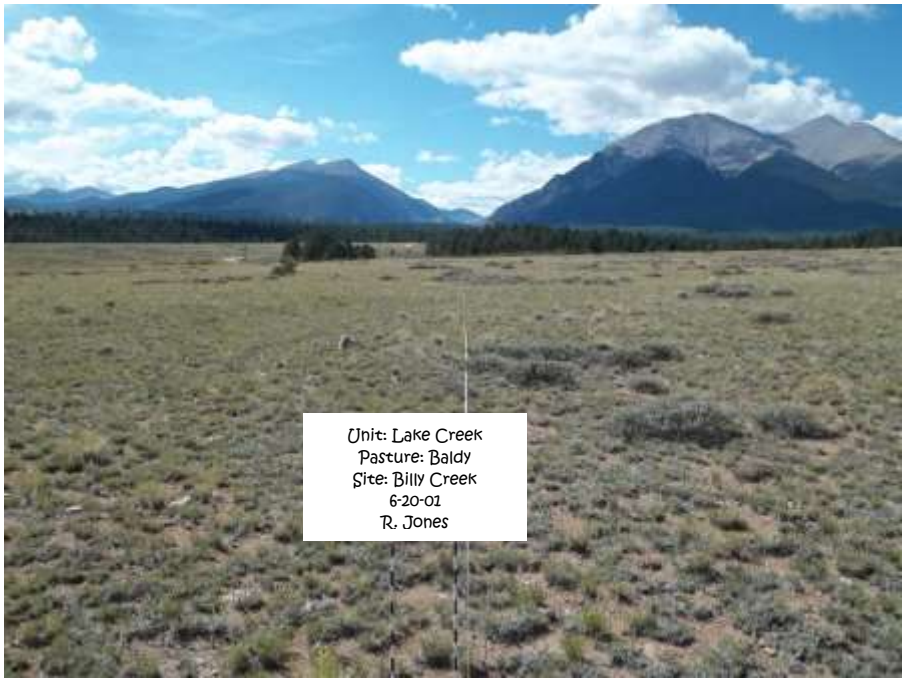
SITE LOCATION MAP



SAMPLE

SITE LOCATION PHOTOGRAPHY

Show **Photo Information Sheet** in all photos.



Vegetation

This form provides basic information regarding plant communities and uses on the monitoring site.

Vegetation

Dominant Plants: Identify the three to five most common plant species present on the study site. Be as specific as possible (for example, Ponderosa pine, Big Sagebrush, Idaho fescue).

Primary Forage Species: Identify the three to five most important indicator forage species. These are most often the species that experience the most use during the season this pasture is grazed. Consult your agency range specialist to determine the agency's primary forage species and key species for this site or pasture.

Vegetation Use

Degree of Use: Indicate the general use (high, moderate, or low) within one or more of the categories listed. Other use categories can be identified if they do not appear on this list. Be as specific as possible. Use the comments to capture anything significantly unique about the use on this site. Again, consult your agency range specialist to determine their definition of high, moderate or low degree of use. This may vary from agency to agency and between field offices within an agency.

SAMPLE

VEGETATION FORM

Dominant Plants: Bluebunch, Wheatgrass, and Nevada Bluegrass

Primary Forage or Indicator ("Key") Species: Bluebunch Wheatgrass

Vegetation Uses

		Degree of Use			
Description		High	Moderate	Low	**Optional Comment**
Livestock	Cow/Calf	☐	■	☐	
Big game	Elk	☐	■	☐	
Rodent	Pocket Gophers	☐	☐	■	
Insects	Morman Crickets	■	☐	☐	
Recreation	Primarily Foot Traffic	■	☐	☐	
	Non-Motorized	☐	☐	■	
	Horse	☐	☐	■	
	Dispersed Camping	■	☐	☐	Habitual camping
Other	Fishing	■	☐	☐	Some banks have been trampled by fishermen

Notes (Use additional pages if necessary)

Weather was cool and wet while cattle were in the pasture.

Because of that, cattle are not using this site as much as they normally do.

Record for Livestock Operators

Actual use information on livestock movement and pasture use is important to a proper monitoring program. This information is invaluable when used with the specific range monitoring techniques outlined in this book. A form is provided for operators who are not currently keeping these kinds of records in a pocket herd book or some other type of record-keeping system. The form we provide is titled “Record for Livestock Operators.”

SAMPLE
RECORD FOR LIVESTOCK OPERATORS

Pasture Name: _____ Observer: _____

If this form is used for several pastures, write the name(s) on the first line for that section.

(Note: Form keeps records often noted in pocket herd books.)

Number of Livestock

Move Date	Put In	Taken Out	Kind & Class	Remarks

Salting/Supplementation Date(s) _____ Product Locations _____

Waters	On Date	Off Date	Effects on Grazing Use

Riding/Herding Date _____ Effects of Grazing Use _____

Use by Other Herbivores or Recreationalists _____ Effects of Grazing Use _____

"Remarks" may address death losses, grazing problems involving water or livestock distribution, forage conditions, or other important matters that influenced the grazing user, such as fire, gates left open, etc. Continue on the back of the form, if necessary. Waters include those that can be turned on or off, such as a trough, or intermittent waters that are occasionally or seasonally dry.

LONG-TERM *OR* SHORT-TERM MONITORING METHODS

Permanent Photos

For important places or pastures without an existing photo, the oldest photo you will ever have is the one you take today! Start taking pictures!!

1. Repeated photographs taken at permanent locations are an effective and efficient method for monitoring. When using this method, it is important to:

    a. Use consistent techniques;

    b. Identify the date and location on the picture;

    c. Take the picture during approximately the same stage of plant growth each year;

    d. Include the same skyline in the landscape picture;

    e. Carefully relocate the photo points each time;

    f. Try to take the picture at approximately the same time of day as the original photograph; and

    g. It is also important to maintain consistency in camera type (lens size), film, timing and associated documentation.

Repeat photographs of landscapes can provide basic documentation of apparent range trend, as well as documenting current year conditions (landscape appearance, drought, etc.). Landscape photos should be taken in the same direction, and from the same designated point, at approximately the same time of year and, when possible, at the same time of day. Photographs that include a distinctive landmark in the background or on the horizon are easier to relocate. If the site has been photographed before, remember; try to duplicate the original photo as closely as possible. Please note that it is difficult to locate previously-established photo points without a portion of the horizon in the photograph. Comparing previous photographs can also be helpful in “framing” the photos consistently from year to year.

Notes:

Photographs from a permanently-marked site (for example, from a fencepost, a prominent rock, a stream crossing, a gully head-cut or other impacted site) can be very effective in demonstrating resource recovery or the need to modify current management.

Finding the location of an old family photograph (i.e., scenery or a fishing trip with a stream in the background), and relocating it can provide good information on past use and trend of a site.

Photo Information Sheet:

Display this sheet in every photograph you take. Use a wide-tipped black marker to write on the sheet. Use colored paper (light blue or green), if possible, so that the paper and writing are more easily readable in the field (white is too bright). Then include the sheet in each photo so that a record of when and where the photo was taken is included in the photo.

SAMPLE

PHOTO INFORMATION SHEET

UNIT NAME:

Grass Valley

PASTURE NAME:

Mountain

STUDY SITE:

#1 South Sheep Corral

OBSERVER:

J. Wilker

DATE:

01 June 2011

*Making copies of this form on light blue or green paper works best in order to reduce glare from the sun. You can also use a white dry board, but be cognizant of any sun glare that may occur when using a white dry board.

Photo-Point Transect

Equipment

- Site Information Form, blank Photo-Point Transect Forms and Photo Information Sheets
- Two six-foot folding carpenter's rules (or three-foot by three-foot plot frame), three transect stakes, 100-foot tape
- Digital camera or 35mm SLR camera with color print film with an exposure index of 100

Procedure

Establish a 100-foot transect, using a 100-foot tape, and install permanent angle iron stakes at both ends (zero-foot and 100.5-foot marks) and the 50.5-foot mark. Complete a Site Information Form for the site.

If possible, locate each end stake using GPS coordinates. This will help in relocating the transect in future years. For all photographs, be sure that the photo information sheet clearly shows in the photo and is legible.

Standing at the stake at the zero foot mark of the transect, take a landscape photograph looking down the transect (e.g., make sure to cover the entire transect, as well as the horizon in the photo).

Using the two carpenter's rules, or an equivalent plot frame, create a three-foot by three-foot square frame and lay it over the tape so it intersects it at the 3.5-foot and 6.5-foot marks and is centered over the tape. (Note: A PVC pipe frame also works well). Standing over the zero-foot mark, take a photograph looking down at the framed section with the 3.5-foot mark in the foreground, and the 6.5-foot mark in the background.

Repeat the previous process (using the frame) at the 18.5-foot to 21.5-foot marks and the 48.5-foot to 51.5-foot marks; the 68.5-foot to 71.5-foot marks, and the 93.5-foot to 96.5-foot marks.

At the 100-foot end of transect, photograph looking back down transect to the zero-foot mark (be sure to include the entire transect and a portion of the horizon in the photo).

Use the Photo Information Sheet in all photographs, if possible. A complete transect will include a total of two landscape photos and a total of five plot photos.

SAMPLE

PERMANENT PHOTO-POINT TRANSECT

Unit Name Lake Creek Pasture Name Baldy

Study Site (# or name) #1 Billy Creek Date 6/20/2001 Observer R. Jones

Grazing System Rest Rotation Season of Use 6/01 to 7/01

Study Located ☐ N ☐ S ☐ E ■ W of Trail Crossing on Lake Creek, 200 ft.

NW 1/4 of SW 1/4 of Section 16 Township 14 N Range 26 E

Photo Direction Northwest

Photo Subject(s) Landscape photo of transect with trail crossing in background

Photo Purpose Monitoring and relocation

Camera Pentax Lens 38mm Film Speed 200

SAMPLE PHOTO

Show **Photo Information Sheet** in all photos.

If taking more than one photo along a transect, indicate the photo view (i.e. N, E, S, W) on the Photo Information Sheet.

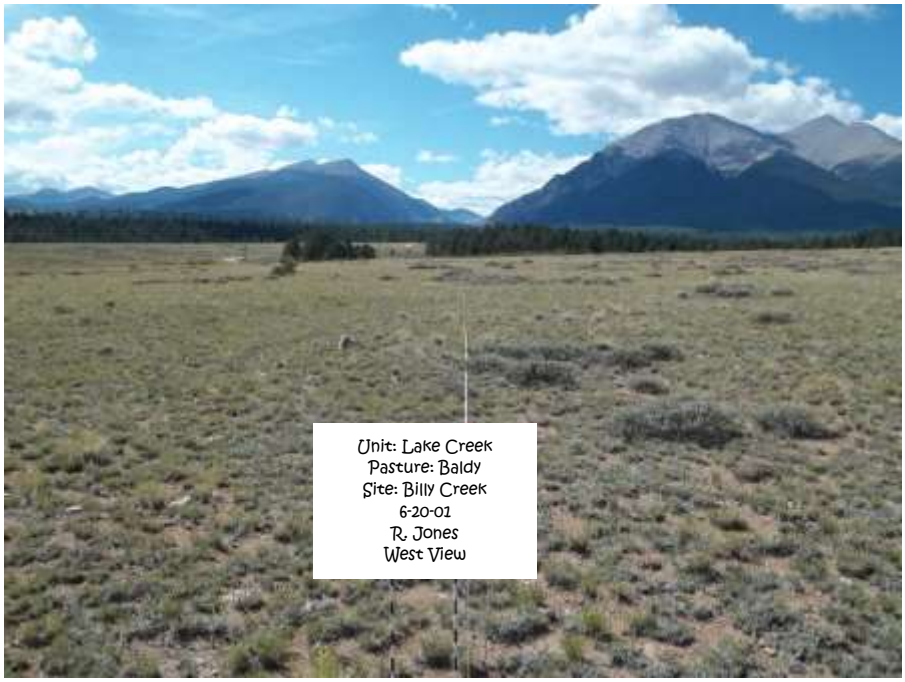


Photo Plots

Equipment

- A quality digital camera or a 35mm SLR camera with color print film is needed. Use an exposure index of 100 (ISO or ASA);
- Three-foot by three-foot frame, two carpenter's rules or PVC pipe

Procedure

- Install a witness post (e.g., fence post or a metal tree tag). All photos taken are then referenced (distance and compass bearing) from this witness post to aid in future relocation. Locate this witness post using GPS coordinates, if possible.
- Measure or pace along the compass bearing to the first photo point from the witness tree. It is often helpful to install a post or painted angle iron at this point (again, GPS this post site, if possible).
- Make sure the photo plot is at least 20 feet away from the witness post. For all photo points, consistently document the photo plot location with respect to the witness post (bearing and distance).
- Place a three-foot by three-foot frame three and one-half feet from the plot stake. Permanently mark at least three corners of the plot frame location with stakes. Paint the steel stakes a bright color, such as orange.
- Complete the photo information sheet, making sure that it is placed so that it clearly shows in the photo and is legible.
- Standing at the photo point post, take photos of the three-foot by three-foot plot. Again, standing at the photo plot stake, take one or more general views (of at least an acre with a horizon for identification of landmarks). Photograph the plot, standing facing along the photo point compass bearing. Note the compass bearing of each of the photos.
- Repeat for the desired number of photo plots for the site. Be sure to document the distance and bearing for each plot from the witness stake or tree.
- It is also important to maintain consistency in camera type (lens size), film, timing and associated documentation.
- If retaking photos from past years, be sure to match the plot frame size used previously. This will normally be a three-foot by three-foot plot.
- Include the Photo Information Sheet in all photos. Light blue or green paper works best in order to reduce glare from the sun
- Do not cast a shadow in the photo, if possible.
- Include at least three photo plots per pasture within areas grazed by livestock and wildlife to capture the range of variation.

- There will normally be at least two photos per photo point (e.g., the plot and the landscape photos). However, this can be adjusted to meet needs for multiple plots and landscape photos (for example, it is common to take photos at each photo point (i.e., at each cardinal bearing – north, south, east and west). Be sure the layout is clearly identified on the form so that it may be relocated for future use.
- Repeat photos at approximately the same plant development stage, regardless of date.
- If past photos were taken in a manner different from that described here, duplicate the original photo to the best extent possible, and document what you did.
- If the purpose of the photo point is to document changes in shrub communities, (for example, willow), it is useful to use a pole or marker board (clearly visible in six-inch bands) placed so that it is clearly visible in the photo and can serve to show the heights of the shrubs in the picture. This approach may also be helpful in showing grass height or sedge/rush height in riparian or wetland sites.

Ocular Plan Composition

General Discussion

This sampling method is used to record ocular estimates of plant species canopy cover, height, shrub form class, phonology and utilization. It is the primary method used for plant composition. Both full and reduced species lists are accommodated by this method. This method is simple to conduct in the field. It is relatively fast and therefore lends itself to many samples over large areas.

Calibration of ocular estimates should be conducted at the outset of inventory projects and occasionally (usually every five to 10 ocular plots) during the project. The examiner must calibrate ocular estimates by using cover-frequency and/or line intercept transect methods.

Advantages and Limitations

The ocular plant composition method is adapted to areas where inventory data must be obtained over large areas using few examiners. It can be used to expand the sample size within a polygon or allotment as a supplement to cover-frequency transects. The ocular plant composition method is rapid and is a good method to use in communities with tall shrubs or trees.

Equipment

Equipment includes a 100-foot tape (marked in feet and tenths of feet), stakes for temporarily marking the ocular plot perimeter, flagging and a camera. Two forms must be completed: *General Field Data Form and Ocular Plant Composition Data Form.*

Sampling Procedure

The plot is typically 1/10 of an acre in size and must be located within a representative, uniform portion of the vegetation and site characteristics being described. This means the plot should

not cross ecotones of either vegetation or site characteristics, and should be representative of the general treatment or management practiced on the area to be described. However, in some cases, the plot may be located to sample vegetation and site conditions within ecotones that are fairly broad.

The ocular plant composition plot is a circular plot with a radius of 37.25 feet and an area of 4,356 square feet (1/10 of an acre). Mark the center of the plot and then measure and flag the outside edge of the plot. Place flagging or metal pins upslope, downslope and along the contour – left and right of plot center. Marking the perimeter of the sample can be omitted once the examiner is comfortable with the plot dimension(s).

Once the plot boundary is delineated, recon the plot and become familiar with plant species, ground cover, vegetation layers (if trees and shrubs are present), and other ecological characteristics.

After examination is complete, return to the center of the plot and visually estimate percentage of canopy cover by species, and percentage of ground cover. Record your observations on the Ocular Plant Composition Form.

SAMPLE
OCULAR PLANT COMPOSITION

Spatial ID:
Purpose/Project: Table Mesa / Red Bluff

Flora ID Source	Colo. Flora: Western Slope
Flora ID Level	*all* plant species identified
Height of Measure	Feet
Diameter Unit of Measure	Inches
Length Unit of Measure	Feet

Sample Unit Size	Live	Dead	U of M
Radius	52.7	74.5	Feet
Length			
Width			

	LF	Species	Layer Heights			Average Diameter	Diameter Location	Canopy Cover	Live (Only)			Dead (Only)			Notes
			Min	Avg	Max				Mat	Age	Vigor	No.	Decay	Len	
1	Tree	Quaking Aspen	10	18	20	4	BH	10	Y	30	M				
2	Tree	Quaking Aspen	1	4	8	1	BH	5	Y	10	M				
3	Tree	Quaking Aspen	3	8	15	2	BH					8	2		
4	Tree	Bebb Willow	1	2	2	1	BH	3	Y						
5	Shrub	Mountain Big Sagebrush	1	2	2			20							
6	Shrub	Mountain Snowberry	0	1	1			2							
7	Shrub	Rubber Rabbitbrush	0	1	1			1							
8	Shrub	Yellow Rabbitbrush	1	1	3			2							
9	Shrub	Prickly Currant	0	1	2			1							
10	Shrub	Red Elderberry	1	1	2			3							
11	Grass	Thurber's Fescue						2							
12	Grass	Blackroot Sedge						2							
13	Grass	Kentucky Bluegrass						10							
14	Grass	Wheeler Bluegrass						50							
15	Grass	Geyer's Sedge						1							
16	Grass	Prairie Junegrass						2							
17	Grass	Threadleaf Sedge						2							
18	Grass	Prairie Junegrass						1							
19	Grass	Western Wheatgrass						5							
20	Grass	Brome						5							
21	Forb	Western Yarrow						25							
22	Forb	Common Dandelion						20							
23	Forb	Oblongleag Bluebells						5							
24	Forb	Pea						10							
25	Forb	American Vetch						10							
26	Forb	Subalpine Larkspur						5							
27	Forb	Sagebrush Buttercup						4							
28	Forb	Alpine Pennycress						1							
29	Forb	Pygmyflower Rockjasmine						1							
30															
31															
32															
33															
34															
35															
36															
37															
38															
39															
40															

*More information on this form can be found in the "Rocky Mountain Region USFS Rangeland Analysis and Management Training Guide

DIAMETER LOCATION

BH =	breast height (4.5 ft)
RC =	root collar
MP =	mid point (down and dead)

TREE MATURITY CLASSES

Y	Young: appear young
I	Immature:appear middle-aged
M	Mature: slightly showing age
O	Overmature: showing age
D	Dead: standing dead

SHRUB MATURITY CLASSES

Y	Young: relatively young plant
M	Mature: slightly showing age
O	Overmature
X	Dead: standing dead

VIGOR CLASSES

F	Full
M	Medium
L	Light
W	Weak

Line-Point Intercept

Line-point intercept is a rapid, accurate method for quantifying soil cover, including vegetation, litter, rocks and biotic crusts. These measurements are related to wind and water erosion, water infiltration and the ability of the site to resist and recover from degradation

Equipment

- Measuring tape (length of transect) – if using a tape measure in feet, use one marked in tenths of feet.
- Two steel pins for anchoring tape.
- One pointer – a straight piece of wire or a rod, such as a long pin flag, at least 75 centimeters (2.5 feet) long , and less than one millimeter (1/25 inch) in diameter.
- Clipboard, Line-Point Intercept Data Form and pencil(s).

Standard Methods

1. Pull out the tape and anchor each end with a steel pin.
2. Line should be taut.
3. Line should be as close to the ground as possible (thread under shrubs using a steel pin as a needle).
4. Being at the “zero” end of the line.
5. Working from left to right, move to the first point on the line. Always stand on the same side of the line.
6. Drop a pin flag to the ground from a standard height.
7. The pin should be vertical.
8. The pin should be dropped from the same height each time. A low drop height minimizes “bounces” off vegetation, but also increases the possibility for bias.
9. Do not guide the pin all the way to the ground. It is more important for the pin to fall freely to the ground than to fall precisely on the mark.
10. Once the pin flag is flush with the ground, record every plant species it intercepts.

Rules

Record the species of the first stem, leaf or plant base intercepted in the “top layer” column, using the PLANTS database species code (http://plants.usda.gov), a four-letter code based on the first two letters of the genus and species, or the common name.

If no leaf, stem or plant base is intercepted, record “None” in the “top layer” column.

Record all additional species intercepted by the pin.

Record herbaceous litter as “L,” if present. Litter is defined as detached dead stems and leaves that are part of a layer that comes in contact with the ground. Record “WL” for detached woody litter that is greater than five millimeters (1/4 inch) in diameter and in direct contact with soil.

Record each plant species only once, even if it is intercepted several times.

If you can identify the genus, but not the species, either use the PLANTS database genus code (http://plants.usda.gov) or record a number for each new species of that genus. Always define the genus portion of the code and the functional group at the bottom of the data form (for example, Artemisia species = AR01).

If you cannot identify the genus, use the following codes

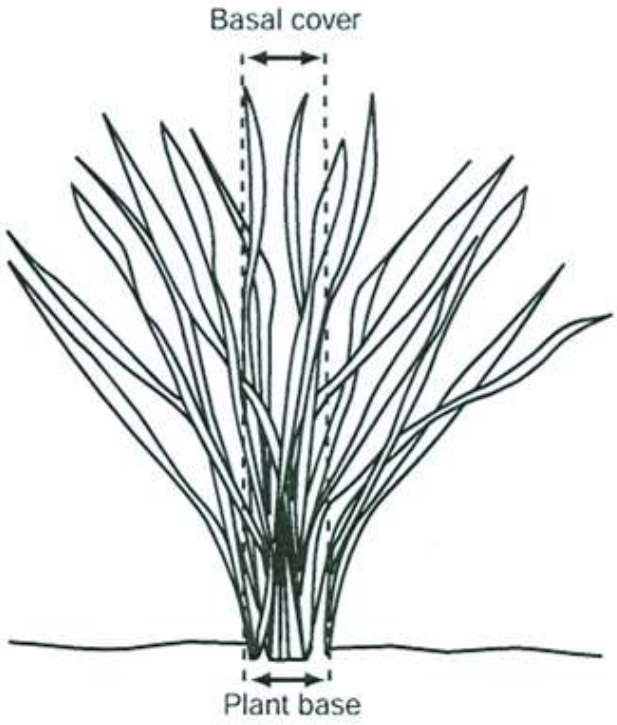
- AF = Annual forb (includes biennials)
- PF = Perennial forb
- AG = Annual grass
- PG = Perennial grass
- SH = Shrub
- TR = Tree

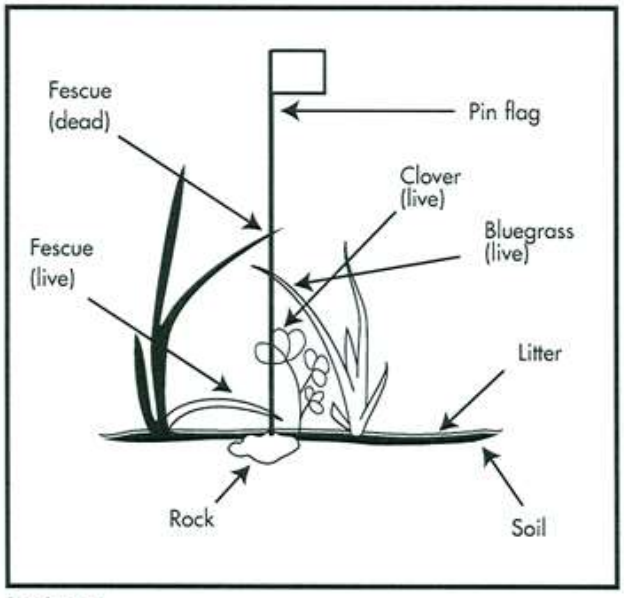
Foliage can be live or dead, but only record each species once. If both live and dead canopy for the same species is hit on the same point, record the live canopy. Be sure to record all species intercepted.

Record whether the pin flag intercepts a plant base, or one of the following in the “soil surface” column.

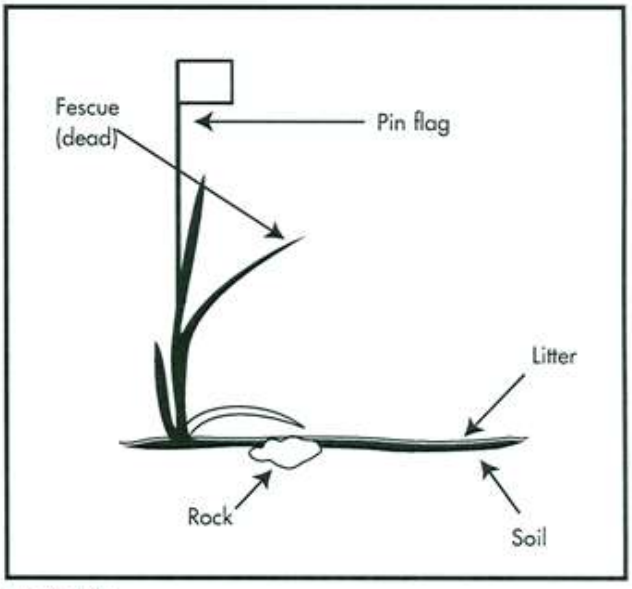
- R = Rock (less than five millimeters / ¼ inch in diameter
- BR = Bedrock
- EL = Embedded litter
- D = Duff
- M = Moss
- LC = Visible biotic crust one soil
- S = Soil that is visibly unprotected by any of the above

Point	Top Layer	Lower Layers			Soil Surface
		Code 1	Code 2	Code 3	
1	Fescue	Bluegrass	Clover	L	R
2	Fescue	L			Fescue
3	Fescue	L			S
etc.					





Point 1



Point 2

Line-Point Intercept Indicator Calculations

Foliar cover (as calculated here) does not include bare spaces within a plant's foliage.

Percentage of foliar cover:

- Count the total number of plant intercepts in the "top layer" column and record this number in the blank provided.
- Plant intercepts include all points where a plant is recorded in the "top layer" column. Do not include points that have a "none" in the "top layer" column.
- Multiply the number of plant intercepts by two (for 50 points per line) and record your "% foliar cover" in the blank provided.

Percentage of bare ground:

- Count the total number of points along the line that have bare ground and record this number in the blank provided.
- Bare ground occurs only when:
- There are no plant intercepts ("none" is recorded in the "top layer" column).
- There are no litter intercepts ("lower layers" columns are empty).
- The pin only intercepts bare soil ("S" recorded in the "soil surface" column).
- Multiply the number of bare ground hits by two (for 50 points per line) and record your "% bare ground" in the blank provided.

Percentage of basal cover:

- Count the total number of plant basal intercepts in the "soil surface" column and record this number in the blank provided.
- Plant basal intercepts occur anytime the pin intercepts a live or dead plant base (species code recorded in the "soil surface" column).
- Multiply the number of basal intercepts by two (for 50 points per line) and record your "% basal cover" in the blank provided.

SAMPLE

LINE-POINT INTERCEPT FORM

Page _____ of _____ Observer _____ Recorder _____

Unit Name _____ Pasture Name _____ Transect ID _____

Direction: _____ Date: _____ Intercept (Point) Spacing Interval = _____ cm (____ in)

Pt.	Top Layer	Lower Layers			Soil Surface	Pt.	Top Layer	Lower Layers			Soil Surface
		Code 1	Code 2	Code 3				Code 1	Code 2	Code 3	
1						26					
2						27					
3						28					
4						29					
5						30					
6						31					
7						32					
8						33					
9						34					
10						35					
11						36					
12						37					
13						38					
14						39					
15						40					
16						41					
17						42					
18						43					
19						44					
20						45					
21						46					
22						47					
23						48					
24						49					
25						50					

% foliar cover =	top layer pts (1st col.) x 2 =
% bare ground* =	pts. (w/NONE over S) x 2 =
% basal cover =	plant base pts. (lat col.) x 2 =

Top layer codes: Species code, common name or NONE (no cover)

Lower layers codes: species code, common name, L (herbaceous litter), WL (woody litter, >5 mm [-1/4 in] diameter)

*Bare ground occurs ONLY when top layer = NONE, lower layers are empty (no L), and soil surface = S.

Unknown Species Codes:

AF = annual forb
PF - perennial forb
AG = annual graminoid
PG = perennial graminoid
SH = shrub
TR = tree
BG = base ground
Blue G = blue gamma

Soil Surface (do not use litter):

Species code (for basal intercept)
R = rock fragment (>5mm [1/4 in] in dia.)
S = Soil w/o any other soil surface code
BR = bedrock
M = moss
LC = visible biofic crust on soil
EL = embedded litter
D = duff

*Be sure to add any abbreviations to this legend for additional species that you list.

Line Point Intercept - Shrubs

The best use of Line Intercept is for measuring the cover of relatively low-growing shrubs, particularly sagebrush, Mountain Mahogany, etc., or riparian cover, such as willows. This method consists of linear measurements of plant intercepts along the course of a line (tape). This method can be used to measure foliar (canopy) and basal cover, as well as providing a means to calculate composition by cover. While this method can be used in a wide variety of plant communities, it is ideal for semi-arid bunchgrass/shrub communities or riparian hardwood communities. This method is best suited where the boundaries of plant growth are relatively easy to determine. It is not well-adapted to estimating cover of single-stemmed species, dense grassland, litter or gravel less than one-half inch in diameter.

Equipment

- Study Location and Documentation Data Form
- Line Intercept Form
- Hammer
- Permanent yellow or orange spray paint
- Three stakes: One-inch angle iron, not less than 16 inches long
- Two tapes: a) one 100-foot or 200-foot, delineated in tenths and hundredths, 2) one 12-foot tape
- Compass
- Steel post and driver

Procedure

In most instances, a minimum of three transects should be established. However, if using this method in conjunction with another method (such as cover-frequency), use the exact same transects for both.

Stretch tape from zero-point stake to the 100-foot stake, anchoring both ends to keep it tight.

Stake at the zero-foot mark, the 50.5-foot mark, and the 100.5-foot mark.

- It is always valuable to take a three-foot by three-foot plot photo and a landscape photo on each transect. See the Cover Frequency Method for instructions.
- Proceed down the tape, beginning at the zero foot mark. Measure the horizontal linear length of each plant that intercepts the transect line. Basal intercept and foliar (canopy) intercept will be recorded separately.
- Measure to the nearest tenth of a foot.
- Measure grasses and grass-like plants, along with rosette-forming plants, at ground level.

- For forbs, shrubs and trees, measure the vertical projection of the foliar cover intercepting one side of the tape.
- Gaps in the canopy of shrubs are common. Disregard small gaps, but show larger gaps as zero intercept.
- Be sure not to inadvertently move the tape to include or exclude certain plants.
- If the measurements are made in tenths and hundredths of feet, the totals are easily converted to percentages.
- The measurements are recorded by species on the line intersect form.

Data Analysis

Cover:

- Calculate the percentage of cover of each plant species by totaling the intercept measurements for all individuals of that species along the transect line, and convert this total to a percentage. Where the measurements are made in tenths and hundredths of feet along a 100-foot transect, the totals for each species are the cover percentages.
- Calculate the total plant cover measured on the transect by adding the cover percentages for all species. This total could exceed 100 percent if the intercepts of overlapping canopies (e.g., shrubs overlapping grass) are recorded.

To calculate composition, divide the percentage of cover for each plant species by the total cover for all plant species.

SAMPLE

LINE INTERCEPT COVER

Spatial ID: _____

Purpose/Project: _____

Minimum Height _____ Transect # _____ of _____

Maximum Height _____ Transect Length _____

Unit Measure _____ Unit of Measure _____

Spp 1			Spp 2			Spp 3			Spp 4			Spp 5		
Start	Stop	Intercept	Start	Stop	Intercept	Start	Stop	Intercept	Start	Stop	Intercept	Start	Stop	Intercept
Total =			Total =			Total =			Total =			Total =		

Species	Age Class					Form Class						Mostly Unavailable		Unavailable
	S	Y	M	D	X	All Available			Largely Available					
	Seedling Sprout	Young Sapling	Mature	Decadent	Dead	Lightly Hedged	Moderately Hedged	Closely Hedged	Lightly Hedged	Moderately Hedged	Closely Hedged			

Step Point

This method is the same as line point intercept, except that it does not use a formal tape and pin to make the measurements. This method involves making observations along a paced transect at pre-determined intervals, to record cover "hits." It measures cover for all individual species, cover by rock, litter, etc., and total cover, and allows calculation of species composition by cover. This method is best suited for grasses, forbs and low shrubs. The greater the structure to the community, the more difficult it becomes to determine hits. This method is good for an initial overview of an area not yet subjected to more intensive monitoring, or as a supplement to the intensive benchmark monitoring.

This method is relatively simple and easy, as long as careful consideration is given to the vegetation type to which it is applied. It is suitable for measuring major characteristics of the ground and vegetation cover of an area. Large areas can easily be sampled, particularly if the cover is reasonably uniform. It is possible to collect a large number of samples within a relatively short period of time.

A limitation of this method is that there can be high variation in the data collected among examiners when sample sizes are small. Tall or armored vegetation reduces the ability to pace in a straight line, and the offset for obstructions described in the procedure adds bias to the data collection by avoiding certain components of the community. Another limitation is that relatively uncommon plant species may not be hit and therefore do not show up in the data.

Equipment

- Study Location and Documentation Date Form
- Cover Data Form
- Tally counter (optional)
- Boots with a 3/16" wide by 1/8" deep notch cut into the toe portion of one of the soles
- Compass

Procedure

- Determine the transect location and bearing.
- Select a prominent distant landmark, such as a peak or rocky point that can be used as the transect bearing point to help keep you on line.
- Determine the number of paces to be used between sample points. It is recommended that the interval be at a minimum of five paces. To lengthen the transect, increase the distance between hits (10 paces, 20 paces, etc.).
- Beginning at the starting point, pace the interval (e.g., number of paces between sample points) along the pre-determined transect bearing. Be careful to stay on line and to avoid bias in your step.

- On the final pace of the pace interval, do not look at the ground as the foot comes down.
- Examine the area in the notch in the toe of your boot – what is found here is recorded as a 'hit,' as follows:
    - At each observation point, identify the ground-level (or plant basal) hit within the notch of your boot toe, and record the data by dot count tally by category and/or plant species in the appropriate section of the cover data form. Look straight ahead to avoid bias.
    - If there is a vegetation canopy layer, lower the pin through the vegetation until a basal, or ground-level, hit is determined. Record the basal or ground-level hit and any subsequent vegetation layers that intersect the pin.
    - For vegetation above three feet in height, a visual observation of plant intercepts above the notch in the boot can be made and recorded as additional canopy hits on the data form.
- When obstructions such as juniper trees, cactus or large rocks are encountered, sidestep at a 90-degree angle then continue to pace parallel to the original direction. When the obstruction is cleared, sidestep back to the original transect pace line and continue pacing for the required interval. If the pace interval falls within the obstruction, once you have returned to the original line, simply continue pacing for three more paces before conducting the sample. If the obstruction is determined to be an important component of the community, this information can be recorded qualitatively on the back of the form.
- In most cases, do not count hits along portions of a transect that have been unnaturally disturbed, such as roads or constructed hiking trails. When such areas are encountered, proceed three paces past the disturbance before resuming the reading of hits along the transect line. However, do record hits on bare ground or on livestock or wildlife trails.

Ground-Level or Basal Hits

Ground-level hits (in addition to basal vegetation hits recorded by plant species) will fall into five cover categories. The five categories are:

- L – Litter
- B – Bare Ground
- G – Gravel (Particle sizes between 1/2 –inch and 10 inches)
- S – Stone (Greater than 10 inches)
- M – Moss or Lichens (soil crusts)

Record the ground-level hits on either live plants (basal) or one of the above categories for each sample point in the ground-level cover section of the form. If there is live vegetation in the basal area hit, do not record any of the five categories noted above as a hit for the same

sample.

Basal hits on live vegetation are identified by species. To count as a basal hit on live vegetation, the plant crown at or below a one-inch height above the ground must be intercepted by the toe notch. Enter the appropriate plant species in the basal or ground-level column, in the basal and canopy/foliar cover section of the form.

Enter the dot count tally for each basal hit on a species in the dot count column in the basal and canopy/foliar cover section of the form when the plant species code is first entered on the form. Enter an additional dot count tally each time there is a basal hit on that species on the transect, except where there are basal and canopy/foliar cover hit combinations.

Ground-Level or Basal Plus Canopy/Foliar Cover Hit Combinations

Identify the ground-level or basal hit (for example, plant species or one of the five categories), as well as any canopy cover hits below three feet in height, intercepted at each point. For canopy cover above three feet, use line-of-sight observations directly perpendicular to the notch in the boot. Enter the appropriate ground-level cover category code and/or plant species code for each level of hit (up to four levels) in the appropriate columns in the basal and canopy/foliar cover section of the form. Enter a dot count tally for each ground-level or basal and canopy cover hit combination when it is first entered on the form, and each time this same combination is encountered on the transect. Enclose plant species names for vegetation cover hits more than 20 feet above ground level in brackets ([ ]).

Data Analysis

- Calculate the percentage of cover for each cover category by dividing the number of hits for each category by the total number of hits for all categories, including vegetation.

- Ground cover is determined by dividing the total number of hits for all categories, except bare ground, by the total number of hits (including bare ground).

- Canopy cover is determined by dividing the total number of hits on vegetation (including all basal and canopy hits) by the total number of hits.

- Basal cover is determined by dividing the number of basal hits by the total number of hits.

Sample
Step Point

Study Number: Red Feather #2	**Date:** 9/28/95	**Examiner:** Josh Gibson	**Pasture:** 1
Allotment Name & Number: Red Feather 11473	**Study Location:** Two miles south of the headquaters wall on west side of the road.		**Number of Points: 100**

Ground-Level Cover

Category	B Bare Ground	**L** Litter	**G** Gravel (2mm - 10")	S Stone (>10")	Vegetation	Total
Dot Count						39
Total Hits	9	12	16	2	61	100
% Cover	9	12	16	2	61	100

Basal and Canopy/Foliar Cover

BSL or Grnd-Lev	Level 1	Level 2	Level 3	Dot Count	Total Hits
Litter	Sideoats Gramma				12
Gravel	Blue Gramma	[JUNIP]			1
Blue Gramma	Juniper				20
Gravel	Sideoats Gramma				4
Squirreltail					2
Litter	Buckwheat				2
Gravel	Squirreltail	Skunkbush Sumac			2
Bare Ground	Goldeneye				2
Gravel	Litter	Goldeneye			4
Bare Ground	Sideoats Gramma				2
Bare Ground	Hairy Grama				3
Litter	Blue Gramma	Sideoats Gramma			2
Blue Gramma	Litter				2
Pricklypear					1
Blue Gramma	Sideoats Gramma				2
				Total	**61**

Notes: Use another page if need be

More information on this form can be found in the "Bureau of Land Management Sampling Vegetation Attributes - Interagency Technical Reference"

Cover and Frequency

This guide provides a simplified variation of one commonly-used method for the determination of cover and frequency, the Daubenmire (or Cover Frequency) method.

This method consists of observing plots along transects at specific intervals, and estimating cover for key species or life forms. The Daubenmire method estimates frequency, basal and general cover categories (including litter), and reproduction of key species (if seeding data is collected).

It is important to establish a photo plot and take both close-up and general view photographs. This allows the portrayal of resource values and conditions, and furnishes visual evidence of vegetation and soil changes over time.

Equipment

- Study Location and Documentation Data Form
- Cover Frequency Form
- Permanent yellow or orange spray paint
- One-inch angle irons (three per transect)
- Cover Frequency (Daubenmire) plot frames (20x50 cm)
- Hammer
- Tally counter (optional)
- Compass
- Steel T-post and driver
- Tape: 100-foot tape delineated in tenths and hundredths.

Note: Before beginning this method, it will be necessary to obtain or build a cover-frequency frame. It is relatively simple to build, but the best option may be to obtain one from an agency person, and then duplicate it. Instructions and drawings can also be obtained from agency personnel.

Procedure

- Cover measurements should be made during the period of maximum growth for the species of interest.
- Establish a 100-foot linear transect (200-foot in sparse vegetation).
- Within each plot frame along the transect, this method estimates cover within six separate cover classes. This makes the method relatively easy to use with training and practice. The cover classes are:

Class	Range	Midpoint
1	0-5%	2.5%
2	5-25%	15.0%
3	25-50%	37.5%
4	50-75%	62.5%
5	75-95%	85.0%
6	95-100%	97.5%

- Stretch the tape from the zero-point angle iron stake to the 100-foot stake, keeping the tape tight and straight.
- Take a photograph of a three-foot by three-foot plot set at the 3.5- to 6.5- foot mark on the tape and centered. Take a landscape photo of the transect line, being sure to include a portion of the horizon. If previous photos exist, attempt to duplicate their location and framing.
- Plot frames will be placed on the right side of the tape at five-foot intervals, beginning at the zero-foot mark (e.g., 20 total plots per transect). The lower right corner of the plot frame will be adjacent to the appropriate foot mark on the tape (for example, zero, five-foot, etc.).
- With the plot frame placed along the tape at the specified intervals, visually estimate the canopy coverage of each important plant species. Note: While it is desirable to record cover classes for every species found in a plot, it is most important to record cover for those key forage species that are used by livestock or wildlife, which are important within that ecological site, and which would be expected to respond to management. Record the data by plot, species and by cover class on the Cover-Frequency form. Canopy coverage estimates are made for both perennial and annual plant species.
- Observe the plot frame from directly above, and estimate the cover class for all live individuals of a specific plant species in the plot. The other key species of plants are evaluated in turn, as each plant species is considered separately. Imagine a line drawn about the leaf tips of the undisturbed canopies (ignoring flowers) and project these polygonal images onto the ground. Decide how much of the plot is covered by the species and, therefore, which classes the canopy coverage of the species falls into, and record that on the form.
- Canopies of live plants extending into, but rooted outside of, the plot frame are estimated, even if the plants are not rooted in the plot frame. For tiny annuals, it is helpful to estimate the number of individuals that would be required to fill five percent of the frame. A quick estimate of the numbers of individuals in each frame will then provide an estimate as to whether the aggregate coverage falls into Class 1 or Class 2, etc. Overlapping canopy cover is included in the cover estimates by species; therefore, total cover may exceed 100 percent.

- Cover estimates should also be made for ground-protecting cover, such as rock, litter and moss/lichens.
- If desired, the cover can be estimated by life form – that is, by tree, shrub, grass and grass-like, and by forb. At times, this broad information may be all that is needed.
- Repeat the above steps for any additional transects. These should normally be parallel to the first transect, and located at least 50 feet apart. A minimum of two transects per benchmark is recommended.

Data Analysis

Average Canopy Cover: For each plant species sampled, divide the total foliar canopy cover within a given transect by the total number of plot frames sampled. This gives average canopy cover by species. The same can be done for a group of species by life form, and should also be done for factors such as bare ground, rock, litter, etc.

Frequency: Divide the number of plot frames in which a given species is found by the total number of plot frames on the transect. Multiply by 100 to convert the value to a percent.

SAMPLE

COVER-FREQUENCY DATA

Spatial ID:

Purpose/Project: Table Mesa / Red Bluff

Flora ID Source: Colorado Flora: Western Slope

Flora ID Level: *all* plant species identified

Cover Class: **x** "6" or ____ "10

Transect # 1 of 3

Transect Length 100

Unit of Measure Feet

Frames/Transect 20

Frame Rad/Len 50

Frame Width 20

Unit Measure CM

	LF	Item	ACC x %Freq = CFI			Canopy Cover Data																			
			ACC	%Freq	CFI	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	SCC
1	Tree	Quaking Aspen																							
2	Tree	Bebb Willow																							
3	Shrub	Mt. Big Sagebrush	17	50	850							2	5		3	3		3		2	2		4	2	2	335
4	Shrub	Mt. Snowberry																								
5	Shrub	Rubber Rabbitbrush	0.8	10	8												T						2			15.5
6	Shrub	Yellow Rabbitbrush	2	15	30					1	3						T									41
7	Shrub	Prickly Currant																								
8	Shrub	Red Elderberry																								
9	Grass	Thurber's Fescue	2	5	10		3																			37.5
10	Grass	Blackroot Sedge	2	10	20													2	2							30
11	Grass	Kentucky Bluegrass	10	50	500	2	2		2	2	2	3			2	3				2			2			195
12	Grass	Wheeler Bluegrass	44	75	3300	4	5	5	6	4	2	3	5	5	4	2	4				3	4	2			870
13	Grass	Geyer's Sedge																								
14	Grass	Prairie Junegrass	2	10	20	2	2																			30
15	Grass	Threadleaf Sedge			0																					
16	Grass	Prairie Junegrass	0.8	5	4																2					15
17	Grass	Western Wheatgrass	5	15	75											2		3					3			90
18	Grass	Brome	3	15	45														2					2	3	67.5
19	Forb	Western Yarrow	25	80	2000	4	4	2	2	3	3	2	2	2		3			4	2	2	4	2	2		497.5
20	Forb	Common Dandelion	21	80	1680			2		2	3	2	T		2	2	2	3	3	2	4	2	2	5	2	410.5
21	Forb	Oblongleaf Bluebells	6	45	270	2	2	2			2		T			2	2	2	2							120.5
22	Forb	Pea	11	50	550		2		2	2	2	2	4			2	2					2	2			220
23	Forb	American Vetch	10	30	300															2	2	3	3	T	5	190.5
24	Forb	Subalpine Larkspur	6	55	330			2			2			2	2	2	2		2		T	T	T		2	121.5
25	Forb	Sagebrush Buttercup	2	15	30										2		2		2							45
26	Forb	Alpine Pennycress	0.8	5	4												2									15
27	Forb	Pygmyflower Rockjasmin	0.8	5	4													2								15
28					0																					
29					0																					
30					0																					
Rq	z	**Wood**	0.9	20	18		T										T		1	2						19
Rq	z	**Litter/Duff**	50	100	5000	4	3	4	3	5	2	2	4	3	4	3	5	4	3	2	4	3	5	4	3	1000
Rq	z	**Moss/Lichen**	5	65	325	T	T		T	T	2				2			T	3	2	T	1		T	1	92
Rq	z	**Basal Veg**	2	100	200	T	1	T	2	T	T	1	T	T	T	T	1	1	T	T	T	T	1	1	T	39.5
Rq	z	**Water**			0																					
Rq	z	**Bare soil <2mm**	33	100	3300	2	3	3	3	2	4	5	3	4	2	3	1	3	2	2	3	4	1	3	1	656.5
Rq	z	**Gravel 2mm-3in**	4	45	180	2	1	T			1					2	T		1					T	3	78
Rq	z	**Cobble 3-10 in**	1	25	25		2						T			1		1							1	24.5
Rq	z	**Stone 10-24 in**	2	10	20												T			3						38
Rq	z	**Boulder > 24in**	0.2	10	2	1									T											3.5
Rq	z	**Bedrock**																								

T	0-1.0% cover	0.5%	2	5.1-25.0% cover	15.0%	4	50.1-75% cover	62.5%	6	95.1-100% cover	97.5%					
1	1.1 - 5.0% cover	3.0%	3	25.1-50.0% cover	37.5%	5	75.1-95.0% cover	85.0%								

*More information on this form can be found in the "Rocky Mountain Region USFS Rangeland Analysis and Management Training Guide"

Cover by Life Form

Cover by Life Form is simply an estimation of the relative amounts of different life forms (e.g., trees, shrubs, grasses, etc.) on a site.

Equipment

- Cover by Life Form Transect and Site Information Forms
- Camera and Photo Information Sheet
- 100-foot tape measure
- Transect stakes
- Two folding carpenter's rules or three-foot by three-foot plot frame

Procedure

- After the transect site is selected, complete the Site Information Form, and install three transect stakes at the zero-foot, 50.5-foot, and 100.5-foot marks, and stretch the tape tight between them, and as close to the ground as possible, without letting vegetation shift the location of the tape. Keep the tape tight, with the zero-foot point directly over the angle of the angle-iron transect stake.
- Before reading the transect, take two photographs; one looking down transect while standing over the zero-foot end of the tape. A Photo Information Sheet, a bearing point you can relocate and skyline should be included in the photo to assist you in locating the transect in the future. The second photograph is taken looking down at a three-foot by three-foot plot frame, centered on the five-foot mark. The picture should be framed using a three-foot by three-foot frame (use the carpenter's rules), centered on the tape.
- In reading the transect, keep the pointer as near to vertical as possible. Always lower the pointer on the same side of the tape. Two people make the process easier and quicker – one person can lower the pointer; the other person can spot the contact and record what is touched.
- Beginning at the one-foot point on the tape measure, lower the plumb bob until initial contact is made with vegetation or the ground surface. Record the data (by dot tally) in the appropriate column and row. If plants overlap, you may find that you record more than one tally for a single footmark. Repeat this at each foot-mark along the tape measure until 100 points have been sampled.
- The life form categories are: Grasses (and grass-like plants, such as sedges); forbs, shrubs, litter, moss and lichen; rock (greater than ¾-inch in diameter) and bare ground.

Data Analysis

When 100 readings are taken, the total number of tallies in each column converts directly to the percent coverage for each life form.

Note: Repeating this data collection over time (i.e., three years, five years, etc.) provides an indication of trend by life form on the site.

SAMPLE

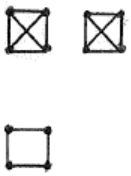
COVER BY LIFE FORM TRANSECT

Unit Name Moonshine Canyon Pasture Name Riparian

Transect ID #3 Date 6/23/2001 Observer J. Conley

Litter includes everything but soil, moss and lichen, rock or, live plants.

You may record dot counts optionally for separate species (e.g., perennial vs. annual species, desirable vs. undesirable species, or noxious weeds vs. native forbs) if doing so will help meet objectives. "Other" categories below may be used for specific species or groupings of interest.

	Grasses	Forbs	Shrubs	Litter	Moss/ Lichen	Rock	Bare Ground
Perennial							
Annual							
Noxious							
Other:							
Other:							
Other:							
Total (=100)	33%	26%	17%	9%	3%	6%	6%

Density of Key Species

Plant density is commonly defined as the number of individual specimens of a given species per unit area. The unit area is less important than making a good count that can be repeated at intervals, providing a rapid method of determining long-term trend. Long-standing research has shown that counting plants has particular value in assessing changes in plant succession, or changes caused by treatments, such as grazing level. This long-term monitoring method is most useful on many Colorado semi-arid rangelands where the plants are sparse and there is a need to determine changes over time. It is much less useful, and more difficult to do, in dense vegetation.

One or more Key Species can be used in this simple, direct and practical method. Counting is perhaps the easiest analytical concept to grasp. However, one difficulty is the recognition of individuals. This is not a problem for many bunch grasses that may be important on an allotment, but shrubs may present a problem. It is also quite difficult or impossible to distinguish individual plants in a sod-forming plant community, such as Western wheatgrass or Kentucky bluegrass. Another question has to do with the transect edges. A decision must be made as to whether or not to count the individual. If half or more of the base of the plant is in the transect or plot, it should be counted.

Procedure

- At each site, stretch out a 100-foot tape to designate the transect. Mark the location of the transect with angle iron stakes at the zero-foot, the 50.5-foot, and the 100.5-foot marks.
- Both ends of the tape should be permanently marked. This can be accomplished by placing a ground stake at each end of the tape at the zero- and 100-foot marks. As with other methods, the user should provide a map to the location and, if possible, further track the location using GPS technology, if feasible.
- Use a belt transect to count key perennial plants. This can be three feet by 100 feet (use any one of the following tools: a three-foot piece of PVC, a yardstick or folding carpenter’s rule placed perpendicular to a 100-foot tape). The count can be conveniently expressed as the number of individual forage specimens per acre. For example, if there were 200 plants in a 100 by three-foot transect, which is equal to 300 square feet, the number per acre would be 29,040. This is based on the fact that there are 43,560 square feet per acre. This is a somewhat unwieldy number. In this case, it might be easier to instead indicate that the count yielded 200 plants in the transect. If the data is expressed as the number of plants per square foot, a very small number would result; in this case 0.66 plants per square foot.

It may also be desirable to count other important species, including weeds and less desirable species. This can be done rather rapidly. For very abundant species, it may be necessary to sub-sample, e.g., by counting only every other five-foot or two-foot segment along the transect. For five-foot intervals, the number of quadrats along a 100-foot tape would be 20, and every

other would be half that, or 10 five-foot by three-foot quadrats along the tape. In the case of two-foot intervals, the number would be 25 two-foot by three-foot quadrats along the tape. Each transect should be 100 feet in length, and a minimum of three should be counted at each key area site on your allotment. The total number per unit area should be recorded and summarized for each of the three transects. The numbers should be carefully recorded on the form and placed in a file for future reference. An excellent way to do this is to place the notes in a computer file that can be placed on a CD for permanently saving the data.

SAMPLE

PLANT DENSITY

Unit Name _____ Pasture Name _____

Transect ID _____ Date _____ Observer _____

Animal Kind/Class _____ Season of use _____ Vegetation Type _____

Area counted - 3 by 100 foot, 10, 3 by 5 foot, or 25, 2 by 5 foot quadrats

KEY SPECIES	TRANSECT 1 Numbers	TRANSECT 2 Numbers	TRANSECT 3 Numbers	Average
Total				
Total				
Total				
Total				

Note: Circle the quadrat sample size; use a dot-count procedure to record the plant numbers.

Stream Bank Stability

Stream bank stability is a key measure of the health of riparian/aquatic systems. While there are many natural processes that affect stability, what we see on the ground is often a reflection of management. Stream banks respond to many of the uses that occur in a watershed, and it can be difficult to distinguish between, for example, the impacts of a road versus livestock grazing. However, because of the high values associated with riparian areas, stream bank stability is frequently an important monitoring item, and it is one that is responsive to management.

Stream bank stability is monitored along the “Greenline.” The Greenline is the first line of perennial vegetation on or near the water's edge. Often, this forms between high and low flows. This is the line that we normally follow for this method. However, where there is no vegetation in this zone, the area between the high and low flows is where the stream bank stability is rated.

General Discussion

Measuring stream bank alteration consists of walking the green line in a riparian area and determining the percentage of stream bank altered by livestock during the current grazing season. The overriding concept behind the procedure is ensuring the continuum of stream bank integrity. Most often, the best indicators of a reduction in bank integrity are livestock hoof prints, sloughing and dislodged stones or longs along the bank/water interface. Physical alternation of the bank by trampling results in widening of the stream channel, and eventually leads to a loss of riparian function.

This method is to be used in conjunction with other short-term riparian monitoring methods, primarily stubble height and woody browse utilization. This method should be taught to permittees so that the results can be used to determine when to move out of a pasture, before the riparian community is damaged. As a rule, stream banks can receive a maximum of 20 to 25 percent alteration annually while continuing to maintain their health and integrity. It is extremely important to realize all riparian communities are unique and some stream systems are much more sensitive to alteration than others. For this reason, stream bank alteration guidelines should only be used for annual management purposes and should not be used as strict requirements until such time as the guidelines have been verified to achieve a desired condition for a specific stream type and riparian community type under similar management strategies.

Training

The Stream bank Alteration Method does not require intensive training for field application. Examiners must be able to recognize trampling impacts from livestock and to record the number of paces of the livestock impact.

Personnel and Equipment

One person can complete and record stream bank alteration transects, however, it is easier and more efficient for a second person to function as a recorder. Equipment required is a

hand-held computer, camera and tally sheet. Additional items include:

- Site Information Form and Stream Bank Stability Form
- Tape measure or folding carpenter's rule
- Camera and Photo Information Sheet

Sampling Procedure

Locate stream bank alteration transects in key areas. Sampling should be done along a 100-foot paced transect on each side of the stream. Stubble height and woody species utilization measurement can, and should be, taken along the same transect.

The examiner should begin on the right-hand side of the stream, facing upstream. As the examiner paces, tally the number of paces where stream bank alteration occurs due to livestock. At the completion of the transect, divide the paces of alteration 200 (total paces in the transect) to get the percentage of stream bank alteration.

Further instructions:

- Locate the stream bank stability monitoring transect within a benchmark area, along a stream reach representative of the area, and of streams being sampled. These areas are normally deeper, fine-textured soils on low gradients. Do not apply this method on bedrock or large boulder stream types.
- The selected stream reach should be all within the same general stream type. That is, the general plant communities, gradient slope, soil texture, streambed makeup (sand, cobble, etc.) and stream shape are fairly consistent.
- Permanently mark the transect beginning using an angle-iron stake or a fence post. The transect begins on the right-hand side of the stream (looking downstream). Take a photograph looking down the transect. Include a relocatable, prominent feature in the photo background such as a rocky point, tree or distinctive horizon. Take additional photos of communities along the transect, as needed.
- Sample for 363 feet along the Greenline, recording the general greenline community encountered at each pace on the form. At the end of the downstream transect (right-side), cross the stream and sample another 363 feet along the upstream Greenline (left-side).

Determine Alteration

The effect of hoof prints on bank integrity will always be a judgment call on the part of the surveyor. Some things to look for are: Is bare soil exposed to running water as a result of hoof print action? Have the roots of bank-stabilizing vegetation been exposed to air or water? Has the bank moved away from the center of the stream? Are hoof prints continuous or isolated? Is pioneering vegetation along the water's edge on gravel bars being trampled enough to allow displacement of bar material? Do pedestals exist along the stream bank?

Bank alteration can be counted to 12 to 18 inches back from the bank, if it would eventually lead to the entire section falling into the stream during peak flow. Vertical cut banks, where there is no evidence of hoof prints along the top of the bank are not counted as altered.

Stream banks with a high percentage of bedrock, large boulders, and grapefruit-size cobble are poor candidates for this method.

Photographs

A series of photographs should be taken of the stream bank alteration transect. The first photograph should be at the starting point, looking upstream. Additional photographs can be taken along the transect as desired.

Data Analysis

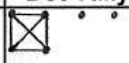
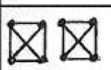
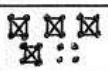
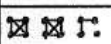
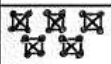
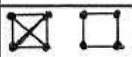
- For each general community type, e.g., willow, alder, rock, wet sedge, etc.), convert the dot tally to a numerical value and show in the ‘count’ field.
- For each community type, multiply the value rating by the count. Record the value in the ‘Rating’ column. Add the ratings by all community types and divide by the total number of count (e.g., number of paces). This gives the overall numerical rating.

Compare the overall numerical rating with the ‘Numerical Stability Rating’ guide near the top of the form to determine the Overall Stability Rating for the site.

SAMPLE
STREAM BANK STABILITY

Unit Name Elk Creek Pasture Name Big Draw

Transect ID #8 Date 8/21/2001 Observer B. Hill

Existing Community Type	Value	Dot Tally	Count	Rating
Anchored rock/logs	10		12	120
Trees (coniferous & deciduous)	7		7	49
Willows	8		21	168
Other shrubs (sagebrush, cinquefoil, etc.)	5		10	50
Wet sedges & rushes	9		44	396
Other sedges	4		13	52
Wet grasses (for example, hairgrass, canarygrass, reedgrass, cordgrass)	8		26	208
Other grasses (for example, bluegrass, redtop, bentgrass, barley, muhly)	3		49	147
Sandbars, loose rock, bare soil (unvegetated areas)	1		18	18
		Total	200	1208
		Numerical Rating		6.0

Multiply the value for each community type by the number of tally points (**count**) to get the **rating**. Sum all the **ratings** and divide by the **total count** (number of paces) to get the **numerical rating**. Use the table below to determine the overall **stability rating** for the riparian/stream reach sampled.

Numerical Rating	Stability Rating
9 - 10	Excellent (very high)
7 - 8	Good (high)
5 - 6	Moderate
3 - 4	Poor (low)
0 - 2	Very Poor (very low)

Landscape Appearance

This method estimates general forage or browse utilization within defined utilization classes. It is especially helpful when grazing or browsing use must be estimated for large areas (such as an entire pasture), and for rangelands with many palatable species instead of a few key species; or where only general information is needed.

The basic difference between the Landscape Appearance method and the Grazed Class method (referenced next in the manual) is that the Grazed Class method focuses on key areas and key forage species, while the Landscape Appearance method focuses on the general utilization of all palatable forage or browse species either on a key area or across a landscape.

While this method is normally completed after the grazing and growing period, it can also be used for in-season trigger monitoring.

For this method, a visual estimate of forage utilization is based on the general appearance of the rangeland. The focus is not on key species, but on all palatable forage or browse species occurring on the site. Utilization levels are determined by comparing observations with the written utilization class descriptions. The summary for a given transect or site is then evaluated against the allowable use criteria (triggers or endpoints for the area) to determine if actions are needed (for example, move pastures), or if you have met your annual management goals.

This method can be accomplished on key areas or can be done by sampling across the entire pasture. If the sampling is conducted on a key area, a paced transect will be established within the key area and the sampling results will be compared with the allowable use criteria established for that key area.

If the sampling is to be conducted for the suitable rangeland of an entire pasture, normally a number of paced transects will be conducted, scattered across the pastures, so as to give the observer a good understanding as to how utilization, and therefore livestock distribution, varies across the area.

However, with sufficient training, an observer can learn to estimate utilization within the grazed classes while walking or riding across the pasture. This latter approach is very helpful if the desire is to develop a general map of utilization and livestock distribution across the pasture. For more details on pasture-wide use, see the Grazing Use Map method.

Equipment

- Site Information and Landscape Appearance Forms
- Camera and Photo Information Sheet

Procedure

- The following assumes that you will be conducting the method on a key area, or perhaps on several key areas within a pasture. For information on pasture-wise use, see the Grazing Use Map method in this guide.

- Select a key area and complete the Site Information Form.
- Determine whether to use the herbaceous or browse species descriptions, depending on which type of plants are most important to management, and use the appropriate form.
- Select a beginning point for a paced transect in the key area. Ensure the transect remains within the same vegetation type (e.g., meadow type, aspen type or open pine type). Take a photograph looking down transect. Include a relocatable, prominent feature in the photo background such as a rocky point, tree or distinctive horizon. If you wish to be able to return to the same general transect area in subsequent years, it may be worthwhile to mark the starting point with a stake.
- Observe and record at least 25 samples per transect. Generally, a sample interval of five paces works well for this method. Record the sample interval on the form.
- Determine how many paces or steps will give you the selected sample interval, and begin pacing along transect (paces are simply two steps). When the predetermined number of paces are reached, examine the immediate area in front of you and determine which Landscape Appearance class most accurately represents the vegetation use, and record your finding as a dot tally in the appropriate row. It is helpful to visualize a 20-foot half-circle immediately in front of where you are standing. Usually, you will only be able to accurately assess plants within about 20 feet of where you are standing.
- Repeat this process until you have at least 25 samples.

Data Analysis

After reaching the end of transect, total the dots in each row and record in the Count column. Then multiply the count for each class by the midpoint displayed in the first column, and record the product. Calculate the average utilization by dividing the sum of products by the total count.

SAMPLE

LANDSCAPE APPEARANCE METHOD (Herbaceous)

Unit Name Lake Creek Pasture Name Baldy

Transect ID #1 Billy Creek Date 6/20/20001 Observer R. Jones

Animal Kind/Class Cow/Calf Season of Use 6/01 to 7/01 Sample Interval 30 ft.

Class (Midpoint)	Dot Tally	(#) Count	# X Midpoint	Description of Landscape Appearance
0-5% (2.5%)		3	7.5	The rangeland shows evidence of no grazing, or of negligible use.
6-20% (13.0%)		6	78.0	The rangeland has the appearance of very light grazing. The herbaceous forage plants may be topped or slightly used. Few current seedstalks and young plants are grazed.
21-40% (30.0%)		12	360.0	The rangeland may be topped, skimmed, or grazed in patches. The low value herbaceous plants are ungrazed and 60-80% of the number of current seedstalks of herbaceous plants remain intact. Fewer than 50% of the young plants are grazed.
41-60% (50.0%)		9	450.0	The rangeland appears entirely covered as uniformly as natural features and facilities will allow. 15-25% of the number of current seedstalks of herbaceous species remain intact. No more than 10% of the number of low-value herbaceous forage plants have been utilized.
61-80% (70.0%)		4	280.0	The rangeland has the appearance of complete search. Herbaceous species are almost completely utilized, with less than 10% of the current seedstalks remaining. Shoots of rhizomatous grasses are missing. More than 10% of the number of low-value herbaceous forage plants have been utilized.
81-94% (88.0%)		3	264.0	The rangeland has a mown appearance and there are indications of repeated coverage. There is no evidence of reproduction or current seedstalks of herbaceous species. Herbaceous forage species are completely utilized. The remaining stubble of preferred grasses is grazed to the soil surface.
95-100% (97.5%)		0	0.0	The rangeland appears to have been completely utilized. More than 50% of the low-value herbaceous plants have been utilized.
	Totals	37	1439.5	
Average Utilization = Midpoint Total / Count Total			39%	

SAMPLE
LANDSCAPE APPEARANCE METHOD (Browse)

Unit Name Canyon Pasture Name Aspen Lake

Transect ID Deer Crossing Date 8/10/2001 Observer E. Smith

Animal Kind/Class Steers Season of Use 7/15/01 to 8/15/01 Sample Interval 30 ft.

Class (Midpoint)	Dot Tally	(#) Count	# X Midpoint	Description of Landscape Appearance
0-5% (2.5%)	• •	2	5.0	Browse plants show no evidence of use; or browse plants have the appearance of negligible use.
6-20% (13.0%)	•	1	13.0	The available leaders of palatable browse plants have the appearance of very light use.
21-40% (30.0%)	• • •	3	90.0	There is obvious evidence of leader use. The available leaders appear cropped or browsed in patches and 60-80% of the available leader growth of the palatable browse plants remains intact.
41-60% (50.0%)		8	400.0	Browse plants appear rather uniformly utilized and 40-60% of the available leader growth of the palatable browse plants remains intact.
61-80% (70.0%)	• •	2	140.0	The use of the browse gives the appearance of complete search. The preferred browse plants are hedged and some plant clumps may be slightly broken. Nearly all available leaders are used and few terminal buds remain on palatable browse plants. Between 20-40% of the available leader growth of the palatable browse plants remains intact.
81-94% (88.0%)	• • • •	4	352.0	There are indications of repeated coverage. There is no evidence of terminal buds and usually less than 20% of available leader growth on the palatable browse plants remains intact. Some patches of 2nd and 3rd year's growth may be utilized. Hedging is readily apparent and the browse plants are more frequently broken. Repeated use at this level will produce a definitely hedged or armored growth form.
95-100% (97.5%)		0	0.0	Less than 5% of the available leader growth on browsed plants remains intact. Some, and often much, of the more accessible 2nd and 3rd year's growth of browse plants has been utilized. All browse plants have major portions broken.
	Totals	20	1000.0	
Average Utilization = Midpoint Total / Count Total			50%	

Grazed Class Method for Forage Plant Utilization

Grazed class utilization monitoring is normally completed in key areas, focusing on a limited number of key species. The basic difference between this method and the Landscape Appearance method is that the Grazed Class method focuses on key areas and key forage species, while the Landscape Appearance method focuses on the general utilization of all palatable forage or browse species either on a key area or across a landscape.

While this method is normally completed after the grazing and growing period, it can also be used for in-season trigger monitoring.

Key forage plant utilization checks are done in key areas with a limited number of key species after the grazing and growing period, unless monitoring or management plans call for different timing. They are tied to key areas.

The basic process involves determining average utilization along transects, based on the use of Utilization Classes. The six utilization classes that follow are used with the grazed class method and refer to the percentage used by weight of the key species. These are the same general utilization classes as used above in the Landscape Appearance method, the difference being that in this method, the classes are applied against specific key species.

1. No Use (0-5%): The key species shows no evidence of use by grazing animals, or shows negligible use.
2. Slight (6-20%): The key species has the appearance of very light grazing. Plants may be topped or slightly used. Current seed stalks and young plants of key herbaceous species are little disturbed. The available leaders of key browse plants are lightly disturbed.
3. Light (21-40%): The key species may be topped, skimmed or grazed in patches. Between 60% to 80% of the current seed stalks remain intact. Most young plants are undamaged. There is obvious evidence of leader use of key browse species. The available leaders appear cropped or browsed in patches, and 21% to 40% of the available leader growth of the key browse plants has been removed. If leaders are only partially removed, some nipping may have occurred on a higher percentage of them.
4. Moderate (41-60%): Approximately half (by weight) of the available forage of key species appears to have been utilized. Fifteen to 25 percent of the number of current seed stalks of key herbaceous species remains intact. Browse plants appear rather uniformly utilized, and 41% to 60% of the available leader growth of key browse plants has been removed. If leaders are only partially removed, some nipping may have occurred on a higher percentage of them.
5. Heavy (61-80%): More than half of the available forage on key species appears to have been utilized. Less than 10 percent of the current seed stalks remain. Shoots of rhizomatous grasses are missing. The key browse species are hedged, and some plant clumps may be slightly broken. Nearly all available leaders are used, and few

terminal buds remain on key browse plants. Approximately 61% to 80% of the available leader growth of the key browse plants has been removed.

6. Severe (81-100%): Key species appear to have been heavily utilized, and there are indications of repeated coverage. There is no evidence of reproduction of current seed stalks of key herbaceous species. Key herbaceous forage species are completely utilized. All available key browse species leaders are used, and some use has been made of the previous year's growth. The remaining stubble is grazed to the soil surface. There is no evidence of terminal buds, and 95% to 100% of available leader growth on the key browse plants has been removed. Much use has been made of the second and third previous years' growth, and the key browse species has been utilized. Hedging is readily apparent, and the browse plants are frequently broken.

Procedure

- Within the key area, establish a paced transect. The transect direction is set by compass bearing and is documented. The direction should be set so that the entire transect will remain within the ecological site selected as a key area.
- It is important to document the location, starting point and direction of the utilization transect so that future utilization studies will be conducted in the same general area.

Utilization transect observations:

- Start at the beginning of the transect and make utilization observations at predetermined intervals along the transect. Observation intervals should be specified on the field form. A good observation interval is five paces, but may vary depending on the type and/or size of the key area.
- At each observation point, utilization of the nearest plants of each key species within a 180-degree arc extending to five feet from the toe of the boot is recorded using the six utilization classes.
- If the key species are not present in the arc, skip this sample point and pace to the next sample point.
- There should be a minimum of 20 evaluation samples on every key species along the transect. The actual number of samples to be obtained will depend upon topography, variability of the vegetation and the best judgment of the examiner (often 20 to 40 points will be observed before there are 20 hits on each key species).
- It is important to work closely with range professionals to determine which species will be considered for measurement, where transects should be established, how long transects should be and the timing for observation intervals to be used for each specific site.

Data Analysis

- Convert the dot count to number of observations for each utilization class.
- Multiply the number of observations in each utilization class by the midpoints of the class intervals.
- Total the products for all classes.
- Divide the sum by the total number of observations on the transect.

Record the average percent utilization on the Grazed Grass Form.

SAMPLE

RANGE UTILIZATION - KEY FORAGE PLANT METHOD

Unit Name _____ Pasture Name _____

Transect ID _____ Date _____ Observer _____

Animal Kind/Class _____ Season of Use _____ Vegetation Type _____

Midpoint	Key Species		Key Species		
(x)	Frequency (f)	f * x	Frequency (f)	f * x	Description of Use Classes
					1. No Use (0%): The rangeland shows no evidence of use by grazing animals.
					2. Slight (1-20%): The rangeland has the appearance of very light grazing. The key herbaceous forage plants may be topped or slightly used. Current seed stalks and young plants of key herbaceous species are little disturbed. The available leaders of key browse plants are little disturbed.
					3. Light (21-40%): The rangeland may be topped, skimmed, or grazed in patches. The low value herbaceious plants are ungrazed, and 60-80 percent of the number of current seed stalks of key herbaceous plants remain intact. Most young plants of key species are undamaged. The available leaders appear cropped or browsed in patches, and 21-40 percent of the available leader growth of the key browse plants have been removed.
					4. Moderate (41-60%): The rangeland appears entirely covered as uniformly as natural features and facilities will allow. Fifteen to 25 percent of the number of current seed stalks of key herbaceous species remain intact. No more than 10 percent of the number of low value herbaceous forage plants are utilized. Browse plants appear rather uniformly utilized, and 41-60 percent of available leader growth of key browse plants has been removed.
					5. Heavy (61-80%): The rangeland has the appearance of complete search. Key herbaceous species are almost completely utilized with less than 10 percent of the current seed stalks remaining. More than 10 percent of the number of low value berbaceous forage plants has been utilized. Approximately 61-80 percent of the available leader growth of the key browse plants has been removed.
					6. Severve (81-100%): The rangeland has a mown appearance, and there are indications of repeated coverage. These is no evidence of reporduction of current seed stalks of key heraceous species. There is no evidence of terminal buds, and 81-100 percent of available leader growth on the key browse plants has been removed. Some, and often much, of the second and third previous year's growth on the browse plants has been utilized.
Totals →					Remarks: _____
∑fx/∑f					

Note: f = the frequency or number of observations within each class interval (f column), x = the class interval midpoint (x column) and ∑ = the summation symbol.

Grazing Use Map

Livestock utilization maps can be very useful management tools. They may help identify key or benchmark areas, distribution patterns or management opportunities. They also may be used to modify the grazing management plan. To map utilization, simply examine the suitable range of the grazing unit and sketch utilization patterns on maps. Landscape appearance, grazed class or other methods are often used to develop the data needed to create the maps. Stubble height, key species and other monitoring methods may also be used.

Use mapping should be done shortly after the growing period and the use period. In most cases, mapping will be done by visual estimate of utilization as supported by a number of transects utilizing a data collection method (such as Landscape Appearance). Establish a transect (see Landscape Appearance, Grazed Class or other methods in this guide) wherever a significant change in use patterns or vegetation type occurs, or whenever it will help the person doing the mapping to feel more comfortable with defining utilization in a given area.

Equipment

- Site Information Form
- Topographic or planimetric map of the grazing unit/allotment (or overlay)
- Camera and Photo Information Sheet

Procedure

It is helpful for the examiner to work from a map showing the boundaries of different plant communities or ecological sites, as use patterns frequently coincide with plant community boundaries.

When using the landscape appearance method, map utilization using the following classes:

0-5%.	61-80%
6-20%.	81-94%
21-40%	95-100%
41-60%	

In most cases, do not attempt to map sites that are too small (for example, smaller than five-acres, or one percent of the pasture). However, for smaller patches of importance to management (such as creeks, springs or seeps), the degree of utilization on these sites should be mapped.

Complete the map with a legend indicating the mapping unit, utilization and/or stubble height. Complete the Site Information Form for each grazing unit (pasture) mapped, and take field notes of conditions observed while mapping.

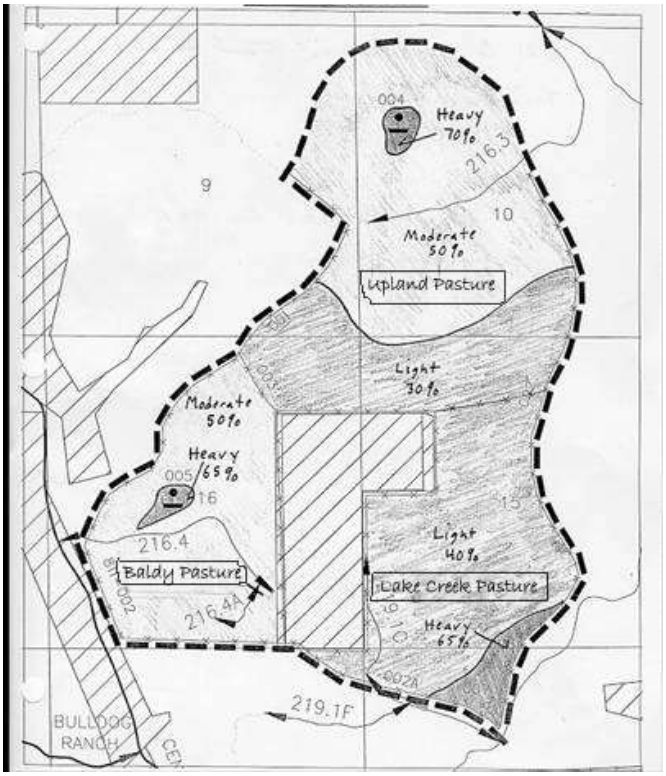
Take photographs showing utilization intensities in representative areas within the grazing unit. Take additional photographs as needed to show unique concerns, opportunities and comparisons.

Data Analysis

There is no real data analysis with this method. The best use of the mapping is to determine where in a given pasture use is higher than desired, and where additional forage is available. This mapping can then help determine potential management changes, such as fencing, water development, salting, etc., that could help make better use of the pasture. Note, this method is not for long-term stocking rate changes.

SAMPLE

Grazing Use Map



Stubble Height

Riparian vegetation provides stream bank protection, traps sediments, contributes to rebuilding degraded stream channels and ensures residual forage and habitat. Retaining an adequate amount of standing herbaceous vegetation (stubble) along the stream banks and within the primary floodplain slows overland water flow velocity from winter and spring runoff, and traps and retains sediments necessary to build and maintain stream banks.

Stubble height monitoring typically occurs on predetermined key species in key areas. Depending on the objectives and resource concerns, key areas may be along the streamside or in wet or dry meadow sites within the riparian area or in upland areas. In some instances,

monitoring is based on species groups, such as sod-forming species with similar growth form and response to grazing.

Stubble height is normally conducted either within season (for example, for the purpose of determining whether allowable use criteria is being reached and, if so, triggering some action, such as moving the livestock to the next pasture); or at the end of the growing season or grazing season, whichever occurs later. This second timeframe is often called “residual stubble height,” and is designed to ensure that enough standing crop remains along the floodplain to trap and hold sediments over winter in order to build stream banks.

Equipment

- Site Information Form and Stubble Height Form
- Tape measure or folding carpenter’s rule
- Camera and Photo Information Sheet

Procedure

- Measurements need to be made on designated key areas, normally within riparian areas (but possibly on uplands), and on predetermined key species. Alternatively, stubble heights may be determined for a group of similar species, such as wet-site, wide-leaved sedges or rushes or dry-site, narrow-leaved grasses or sedges. The key is that this group of species be utilized by, and react similarly to, grazing effects.
- For riparian areas, sampling should be done on both sides of a stream segment along the Greenline, when feasible. For upland or meadow sites, measurements should be taken along a predetermined course or transect.
- Once the riparian segment or transect site has been selected, take a photograph looking down the stream segment or transect. Include a relocatable, prominent feature in the photo background, such as a rocky point, tree or distinctive horizon. Determine the distance between observation points (this is the sample interval). This will vary depending on the size and shape of the site selected. Record the sample interval in the Sample Interval blank at the top of the form.
- Determine how many paces (two steps per pace is typical) will give the selected sample interval, and begin pacing along the Greenline or the predetermined transect course. Stop at each sample interval and do the following:
    - Locate the individual plant nearest the toe of your boot for the identified key species. The nearest plant may not be immediately at your toe.
    - Record the average stubble height (average leaf length) for each key species. Where it is difficult to tell where one plant starts and another stops, visualize a three-inch circle and sample the key species plants within that circle. Estimate and record the average stubble height within the three-inch circle.
- If you are sampling for more than one key species, or grouping of similar species,

record stubble height for each key species. There will be a minimum of 30 stubble height measurements for each species. Additional readings can be taken if variability on the site warrants.

After a minimum of 30 samples have been recorded, total the measurements for each column, and divide by the number of plants sampled for each species to calculate the average stubble height.

SAMPLE

STUBBLE HEIGHT

Unit Name: NE Pine Creek Pasture Name: Upland

Transect ID: #2 Date: 8/4/2000 Observer: R. Werf

Animal Kind/Class: Cow/Calf Season of Use: 7/15/00 to 8/15/00 Sample Interval: 30 ft.

Record at least 36 stubble heights for each species or species groups. More readings can be taken if desired.

Species (Group): Beaked Sedge

	Column A		Column B
1	4	26	7
2	7	27	7
3	6	28	5
4	8	29	6
5	2	30	9
6	5	31	9
7	3	32	4
8	6	33	4
9	9	34	6
10	4	35	7
11	4	36	6
12	3	37	
13	2	38	
14	5	39	
15	4	40	
16	2	41	
17	3	42	
18	6	43	
19	2	44	
20	7	45	
21	4	46	
22	5	47	
23	3	48	
24	6	49	
25	5	50	
Sub	115	Sub	70

Grand Total: 185

Average Height (Tot/#): 5.1

Species (Group):

	Column A		Column B
1	3	26	6
2	5	27	4
3	6	28	4
4	4	29	7
5	2	30	9
6	1	31	6
7	7	32	5
8	4	33	3
9	3	34	3
10	3	35	2
11	5	36	1
12	6	37	
13	4	38	
14	2	39	
15	4	40	
16	4	41	
17	3	42	
18	6	43	
19	6	44	
20	8	45	
21	6	46	
22	2	47	
23	4	48	
24	3	49	
25	3	50	
Sub	104	Sub	50

Grand Total: 154

Average Height (Tot/#): 4.3

Species (Group):

	Column A		Column B
1		26	
2		27	
3		28	
4		29	
5		30	
6		31	
7		32	
8		33	
9		34	
10		35	
11		36	
12		37	
13		38	
14		39	
15		40	
16		41	
17		42	
18		43	
19		44	
20		45	
21		46	
22		47	
23		48	
24		49	
25		50	
Sub		Sub	

Grand Total:

Average Height (Tot/#):

Grazing Response Index

The Grazing Response Index (GRI) is a tool to evaluate the effectiveness of applied livestock management on a given pasture for a given grazing season. It is applied either during the growing season or, preferably, shortly after the livestock leave. It provides an assessment of grazing impacts on three key plant and rangeland health factors. By doing so, it aids the operator in planning for future years' management.

Note: This index is based on grazing use that occurs during the growing season, and at the end of the grazing period. This only marginally applies to grazing use when plants are dormant. Dormant season usually occurs after plants have had full opportunity to grow prior to use, hence an opportunity value of +2. Also, intensity is not as critical a parameter during the dormant season, because we are not concerned with producing regrowth.

Equipment

- Grazing Response Index Form

Procedure

- GRI considers three factors critical to rangeland and plant health: frequency, intensity, and opportunity.

Frequency

Frequency is the number of times key forage plants are defoliated (grazed) during the grazing period. It is dependent on the length of time forage plants are exposed to the grazing animal. Approximately seven to ten days are required for a plant to grow enough to be grazed again during late spring or early summer, when plants are experiencing rapid growth. Local knowledge of the area is needed to determine how fast the plants are growing.

To obtain an estimate of how many times plants were (or will be) defoliated during a grazing permit, divide the number of planned grazing days by seven (or up to 10 if growth is slower, as in mid-summer). Using seven is more conservative, because it will give the highest probable number of times the plants could be grazed. An index value of **+1 to -1** is assigned as follows:

Number of Defoliations	Value
1	+1
2	0
3 or more	-1

Intensity

Intensity of defoliation is the amount of leaf material removed during the grazing period. The primary concern is the amount of photosynthetic active leaf material remaining for the plant to recover from grazing. This is not an estimate of percentage of utilization; generally, less than 40 percent defoliation will not inhibit plant growth (depending on the specific species, site, and

season of use). It is related to stocking rate. Intensity is described using three general levels of use, as follows:

Amount of Use	Percent	Value
Light	<40%	+1
Moderate	40-55%	0
Heavy	>55%	-1

Opportunity

Opportunity is the amount of time plants have grown prior to grazing, or to re-grow after grazing. This factor is related to time of use. Opportunity is the one factor most highly related to long-term health and vigor of the vegetation. It is dependent on soil moisture, temperature and leaf area. This factor is very important for sustaining healthy plants, thus the relative rankings for this attribute are doubled. Opportunity to grow or re-grow is described as follows:

Opportunity to Grow or Re-Grow	Value
Full Season	+2
Most of Season	+1
Some Chance	0
Little Chance	-1
No Chance	-2

Determining opportunity is a judgment call, based on the appearance of vegetation at the end of the growing season. If the key forage plants look like they were not grazed, or were just barely used, then a value of +2 would be appropriate. If the plants look like they were used but re-grew fairly well, then use +1. Obviously, if the area has the appearance of being heavily used with no-regrowth, assign a -2 value.

Even though opportunity is based on the appearance of the vegetation at the end of the growing season, there are some general guidelines that can help you make the determination. For example, a pasture that is used season-long can be expected to rate -2 (No Chance). An allotment with two pastures in rotation will likely be in the zero (Some Chance) or -1 (Little Chance) range. Allotments with multiple pastures that are used at different times each year will usually receive the higher ratings of +2 or +1. These guidelines can help you get started, but the final rating should be based on the appearance of the forage vegetation.

Data Analysis

The values for frequency, intensity and opportunity are additive. The overall rating of the expected response to grazing is the sum of all three values. This result is a numerical value that is positive, neutral or negative. The index is a simple method to evaluate whether the grazing system, as applied in the specific year, has long-term beneficial, neutral or negative effects to the rangeland forage. GRI gives a more comprehensive basis to plan future use that will maintain or improve plant health, structure and vigor. (See utilization maps).

SAMPLE
GRAZING RESPONSE INDEX

Use this method to evaluate each pasture, or several sites within a pasture. Each row represents one GRI rating. **To determine the GRI, add all three values (frequency, intensity, and opportunity) and record the sum in the Total column.** Several sites within a pasture can be averaged to obtain an overall rating for the entire pasture. Complete the Site Information Form for each site or pasture.

Unit Name Lake Creek Pasture Name(s) Baldy / Aspen Lake / Butch Cassidy / Long Draw

Date 7/21/2001 Observer E. Tubb

Grazing System Rest Rotation Season of Use 6/1/01 to 7/15/01

Frequency

# of Defoliations	Value
1	+ 1
2	0
3 or more	- 1

Intensity

Amount of use	Percent	Value
Light	<40%	+ 1
Moderate	40-55%	0
Heavy	>55%	- 1

Opportunity

Opportunity to Grow or Regrow	Value
Full season	+2
Most of season	+1
Some chance	0
Little chance	-1
No chance	-2

Pasture Name	Site ID	Frequency	Intensity	Opportunity	GRI (Total)
Baldy	#1	+1	-1	+1	+1
	#2	0	0	-1	-1
	#3	0	0	+1	+1
Aspen Lake	#1	-1	-1	-2	-4
	#2	+1	0	-2	-1
Butch Cassidy	#1	+1	0	+1	+1
	#2	-1	+1	-1	+1
Long Draw	#1	-1	0	-1	-2
	#2	0	+1	0	+1
	#3	0	-1	+1	0
	#4	-1	0	+1	0

Rooted-Nested Frequency

For monitoring trend, the Rooted-Nested Frequency Method analyzes changes in frequency of individual species over time on a specific site. Desired plant communities are selected and documented during allotment management planning. Increases or decreases in frequency of the species within the plant community can be estimated with the Rooted-Nested Frequency Method.

An increase in a species that is dominant in the desired plant community can be interpreted as desirable or trending “toward” the desired plant community (DPC), and a decrease in a dominant species can be considered trending “away from” DPC.

Advantages and Limitations

Frequency sampling is an objective method that is simple to perform and easy to duplicate from year to year. The only decisions to be made are plant species identification, and whether or not the listed species occurs within the plot. This method encourages consistent, accurate observations while minimizing bias among different examiners. Rooted-Nested Frequency is the most reliable method for determining long-term trend, but is probably the most time-consuming.

Frequency data is collected in different sized plots with each placement of the nested frame. When a plant occurs within a plot, it also occurs in all successively larger plots. Frequency of occurrence for various sized plots can be analyzed, although frequency is recorded for only one size plot. This eliminates problems with comparing frequency data from different sized plots. Use of the nested plot configuration improves the chance of selecting a proper plot size for frequency sampling. Frequency data is not subject to substantial fluctuations with climate.

This method should only be used when the highest level analysis intensity is required.

Frequency determinations give a good indication of changes in the occurrence of individual species over time. Frequency does not, however, provide a good description of the vegetative characteristics of a plant community, or why the vegetation is changing. Characteristics like cover, density and spatial arrangement cannot be determined through frequency measures. A combination of the Cover-Frequency Method and Rooted-Nested Frequency Method will best describe changes in the vegetation and soil components of a plant community.

Personnel and Equipment

Two examiners are required for Rooted-Nested Frequency Method. It is best if one person does the observations and the other records them. Two 100-foot tapes are required: one for the baseline and the other to be moved from transect position to transect position. A Rooted-Nested Frequency frame, and a die for randomly determining the sampling scheme are required. Other equipment is the same as for cover-frequency transects.

Sampling Procedure

Upon selecting the study site and/or finding the previously-established benchmark, the location should be documented and any changes in reference points or status of the transect noted.

Photographs

Photographs are an important part of the study and should portray changes taking place on the ground. They should provide a good visual image of the site and help relocate the study for future measurements.

As a minimum, a general view and a close-up photo of the three-foot by three-foot plot should be taken before taking any measurements. Photos should be taken from the 0.0 mark on transect one, or at the best suitable point. Additional photos are encouraged.

Sample Design

The typical plot sampled in the Rooted-Nested Frequency Method is a square measuring 100 by 100 feet. In some cases, due to a mosaic of vegetation types, this shape may be changed to ensure uniformity in the sample vegetation community. The typical baseline for the transects is 100 feet long and is located perpendicular to the slope (on the slope contour) with the zero-foot mark on the left and the 100-foot mark on the right as the examiner faces upslope. Transects are placed perpendicular to the baseline (that is, parallel with the slope) and are sampled starting at the baseline. The baseline runs from west to east on flat areas with the zero-foot mark on the west end and the 100-foot mark on the east end. On flat areas, transects are located from the baseline to the north.

SAMPLE

ROOTED-NESTED FREQUENCY DATA

Spatial ID:

Purpose/Projects: Table Mesa / Red Creek

Plant ID *all* plants are being measured

Transect # 1 of 5

Transect Length 100

Unit of Measure Feet

Frames/Transect 10

Rooted Nested Ratio 2

	LF	Item	Rooted Nested Frequency										
			1	2	3	4	5	6	7	8	9	10	SRF
1	Shrub	Mt. Big Sagebrush			2				1				7
2	Shrub	Mt. Snowberry											
3	Shrub	Yellow Rabbitbrush		3									3
4	Grass	Thurber's Fescue	2	1			3			4		1	11
5	Grass	Blackroot Sedge		2		1	2		1		2		8
6	Grass	Kentucky Bluegrass	4	3	1	4	4	2	3	3		1	25
7	Grass	Wheeler Bulegrass	2		1		3	4		2			12
8	Grass	Prairie Junegrass	1			2			3				6
9	Grass	Prairie Junegrass			3		1				2		6
10	Grass	Brome						3					3
11	Forb	Western Yarrow	4		2	2	3		2	2	3	1	19
12	Forb	Common Dandelion		2	2		2	2		1	3	4	16
13	Forb	Flowery Phlox		4		4		2	2	3		1	16
14	Forb	Oblongleaf Bluebells				1				1			2
15	Forb	Pea						2					2
16	Forb	Buckwheat						2					2
17	Forb	Subalpine Larkspur									1		1
18	Forb	Northern Bedstraw											
19	Forb	Alpine Pennycress			2			4					6
20													
21													
22													
23													
24													
25													
26													
27													
28													
29													
30													
Rq	Z	**Wood**											
Rq	Z	**Litter/Duff**	2	1	4	2	1	2	4		1	2	19
Rq	Z	**Moss/Lichen**				1							1
Rq	Z	**Basal Veg**	1					2			3	1	7
Rq	Z	**Water**											
Rq	Z	**Bare Soil <2mm**	1	3		1	2			4		1	12
Rq	Z	**Gravel 2mm-3in**					1						1
Rq	Z	**Cobble 3-10in**											
Rq	Z	**Stone 10-24in**											
Rq	Z	**Boulder >24in**											
Rq	Z	**Bedrock**											

*More information on this form can be found in the "Rocky Mountain Region USFS Rangeland Analysis and Management Training Guide"

SAMPLE

ROOTED-NESTED FREQUENCY SUMMARY

Spatial ID

Purpose/Project Table Mesa / Red Creek

Plant ID *all* plants are being measured

Transect Number 5

Transect Length 100

Unit of Measure Feet

Frames/Transect 10

Rooted Nested Ratio 2

	LF	Item	Transect 1 SRF	Transect 2 SRF	Transect 3 SRF	Transect 4 SRF	Transect 5 SRF	Transect 6 SRF	Transect 7 SRF
1	Shrub	Mt. Big Sagebrush	7	10	5	4	12		
2	Shrub	Mt. Snowberry		3		2			
3	Shrub	Yellow Rabbitbrush	3		2	6	8		
4	Grass	Thurber's Fescue	11	4	1				
5	Grass	Blackroot Sedge	8	2	3	14	6		
6	Grass	Kentucky Bluegrass	25	12	19	12	18		
7	Grass	Wheeler Bluegrass	12	5	14	12	6		
8	Grass	Prairie Junegrass	6		4		1		
9	Grass	Prairie Junegrass	6		1	7			
10	Grass	Brome	3	5	6	1			
11	Forb	Western Yarrow	19	24	16	26	14		
12	Forb	Common Dandelion	16	8	12	20	18		
13	Forb	Flowery Phlox	16	4	1		6		
14	Forb	Oblongleaf Bluebells	2	1		2			
15	Forb	Pea	2		1		5		
16	Forb	Buckwheat	2			1			
17	Forb	Subalpine Larkspur	1				4		
18	Forb	Northern Bedstraw		4		3			
19	Forb	Apline Pennycress	6				1		
20	Forb	Drummond's Milkvetch		1	1				
21	Forb	Silvery Lupine		2	3	2			
22									
23									
24									
25									
26									
27									
28									
29									
30									
Rq	**Z**	**Wood**							
Rq	**Z**	**Litter/Duff**	19	20	12	22	14		
Rq	**Z**	**Moss/Lichen**	1		3				
Rq	**Z**	**Basal Veg**	7	10	5	4	8		
Rq	**Z**	**Water**					2		
Rq	**Z**	**Bare soil <2mm**	12	10	16	14	14		
Rq	**Z**	**Gravel 2mm-3in**	1				2		
Rq	**Z**	**Cobble 3-10in**			4				
Rq	**Z**	**Stone 10-24in**							
Rq	**Z**	**Boulder >24in**							
Rq	**Z**	**Bedrock**							

*More information on this form can be found in the "Rocky Mountain Region USFS Rangeland Analysis and Management Training Guide"

Proper Functioning Condition

What It Is and What It Isn't

PFC is: A methodology for assessing the physical functioning of riparian and wetland areas. The term PFC is used to describe both the **assessment** process, and a defined, on-the-ground **condition** of a riparian-wetland area. In either case, PFC defines a minimum or starting point.

The PFC **assessment** provides a consistent approach for assessing the physical functioning of riparian-wetland areas through consideration of hydrology, vegetation, and soil/landform attributes. The PFC assessment synthesizes information that is foundational to determining the overall health of a riparian-wetland area.

The on-the ground **condition** termed PFC refers to *how well* the physical processes are functioning. PFC is a state of resiliency that will allow a riparian-wetland system to hold together during a 25 to 30 year flow event, sustaining that system's ability to produce values related to both physical and biological attributes.

PFC isn't: The sole methodology for assessing the health of the aquatic or terrestrial components of a riparian-wetland area.

PFC isn't: A replacement for inventory or monitoring protocols designed to yield information on the "biology" of the plants and animals dependent on the riparian-wetland area.

***PFC can*:** Provide information on whether a riparian-wetland area is physically functioning in a manner which will allow the maintenance or recovery of desired values, e.g., fish habitat, neo-tropical birds, or forage, over time.

PFC isn't: **Desired (future) condition.** It is a prerequisite to achieving desired condition.

PFC can't: Provide more than strong clues as to the actual condition of habitat for plants and animals. Generally a riparian-wetland area in a physically non-functioning condition will not provide quality habitat conditions. A riparian-wetland area that has recovered to a *proper functioning condition*, would either be providing quality habitat conditions, or would be moving in that direction if recovery is allowed to continue. A riparian-wetland area that is functioning-at-risk would likely lose any habitat that exists in a 25 to 30 year flow event.

Therefore: obtain a picture of riparian-wetland area health, including the biological side, one must have information on *both* physical status, provided through the PRC assessment, and biological habitat quality. Neither will provide a complete picture when analyzed in isolation. In most cases, proper functioning condition will be a prerequisite to achieving and maintaining habitat quality.

PFC is: A useful tool for prioritizing restoration activities. By concentrating on the "at risk" systems, restoration activities can save many riparian-wetland areas from degrading to a non-functioning condition. Once a system is non-functional; the effort, cost, and time required for recovery is dramatically increased. Restoration of non-functional systems should be reserved for those situations where the riparian-wetland has reached a point where recovery is possible,

when efforts are not at the expense of "at risk" systems, or when unique opportunities exist. At the same time, systems that are properly functioning are not the highest priorities for restoration. Management of these systems should be continued to maintain PFC and further recovery toward desired condition.

PFC is: A useful tool for determining appropriate timing and design of riparian-wetland restoration projects (including structural and management changes). It can identify situations where in-stream structures are either entirely inappropriate or premature.

PFC is: A useful tool that can be used in watershed analysis. While the methodology and resultant data is "reach based", the ratings can be aggregated and analyzed at the watershed scale. PFC, along with other watershed and habitat condition information, helps provide a good picture of watershed health and the possible causal factors affecting watershed health. Use of PFC will help to identify watershed scale problems and suggest management remedies and priorities.

PFC isn't: analysis in and of itself, or a replacement for watershed analysis.

PFC is: A useful tool for designing implementation and effectiveness monitoring plans. By concentrating implementation monitoring efforts on the "no" answers, greater efficiency of resources (people, dollars, time) can be achieved. The limited resources of the local manager in monitoring riparian wetland parameters can be prioritized to those factors that are currently "out of range" or at risk of going out of range. The role of research may extend to validation monitoring of many of the parameters.

PFC isn't: A long-term monitoring tool, but it may be an appropriate part of a well-designed monitoring program.

PFC isn't: Going to provide monitoring answers about attainment of desired conditions. However, it can be used to provide a thought process on whether a management strategy is likely to allow attainment of desired conditions.

PFC can: Replace the frequency and sometimes the extent of more data and labor-intensive inventories. PFC can reduce process by concentrating efforts on the most significant problem areas first and thereby increase efficiency.

PFC can't: Be the need for more intensive inventory and monitoring protocols. These will often be needed to validate that riparian-wetland area recovery is indeed moving toward or has achieved desired conditions, e.g., good quality habitat, or simply establish the quality of existing habitat.

PFC is: A qualitative assessment based on quantitative science. The PFC assessment is intended for individuals with local, on-the-ground experience in the kind of quantitative sampling techniques that support the checklist. These quantitative techniques are encouraged in conjunction with the PFC assessment for individual calibration, where answers are uncertain, or where experience is limited. PFC is also an appropriate starting point for determining and prioritizing the type and location of quantitative inventory or monitoring necessary.

PFC isn't: A replacement for quantitative inventory or monitoring protocols. PFC is meant to complement more detailed methods by providing a way to synthesize data and communicate results.

SAMPLE

Proper Functioning Condition Standard Checklist

Riparian-Wetland Area: _____

Date: _____ Segment/Reach I.D.: _____ Miles: _____

ID Team Observers: _____

YES	NO	N/A	HYDROLOGIC
			Flood plain inundated in "relatively frequent" events (1-3 years)
			Active/stable beaver dams
			Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region
			Riparian zone is widening or has achieved potential extent
			Upland watershed not contributing to riparian degradation

YES	NO	N/A	VEGETATIVE
			Diverse age structure of vegetation (recruitment for maintenance/recovery)
			Diverse composition of vegetation (for maintenance recovery)
			Species present indicate maintenance of riparian soil moisture characteristics
			Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high streamflow events
			Riparian plants exhibit high vigor
			Adequate vegetative cover present to protect banks and dissipate energy during high flows
			Plant communities in the riparian area an adequate source of coarse and/or large woody debris

YES	NO	N/A	EROSION DEPOSITION
			Floodplain and channel characteristics (i.e., rocks, overflow channels, coarse and/or large woody debris) adequate to dissipate energy
			Point bars are revegetating
			Lateral stream movement is associated with natural sinuosity
			System is vertically stable
			Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)

Remarks

Functional Rating:
Proper Functioning Condition _____
Function - At Risk _____
Nonfunctional _____
Unknown _____

Functional At-Risk Trend:
Upward _____
Downward _____
Not Apparent _____

Are Unacceptable Conditions Outside BLM Control? _____

If YES, mark factors causing conditions:

Flow Regulation _____
Augmented Flows _____
Road Encroachment _____
Upstream Channel _____

Channelization _____
Mining Activity _____
Oil Field Water _____
Other _____

GLOSSARY

BARE GROUND: All land surface not covered by vegetation, rock greater than three-quarter-inch diameter, or litter greater than three-quarter-inch in diameter. See Ground Cover.

CANOPY COVER: The percentage of ground covered by a vertical projection of the outermost perimeter of the natural spread of foliage of plants. Small openings within the canopy are included. Total canopy cover may exceed 100 percent. Synonymous with Crown Cover.

COMPOSITION: The proportions (percentages) of various plant species in relation to the total on a given area. It may be expressed in terms of relative cover, relative density, relative weight, etc.

COVER (Ground): The percentage of material, other than bare ground, covering the land surface. It may include live and standing dead vegetation, litter cobble, gravel, stones, and bedrock. Ground cover plus bare ground would total 100 percent.

COVER (Foliar): The percentage of ground covered by a downward vertical projection of the aerial portion of plant foliage, excluding small openings in the canopy. Foliar cover is always less the canopy cover. Total foliar cover of all species may exceed 100 percent.

COVER TYPE: A taxonomic unit of vegetation classification referencing existing vegetation. Cover type is a broad taxon based on existing plant species that dominate, usually within the tallest layer.

DENSITY: Number of individuals or stems per unit area. Density **DOES NOT** equate to any kind of cover measurement.

DESIRED PLANT COMMUNITY: Of the several plant communities that may occupy a site, the one identified through a management plan that best meets the objectives for the site. It must protect the site as a minimum. The desired plant community must be consistent within the capability of the area to produce vegetation through management, land treatment or a combination of the two.

EROSION PAVEMENT: A concentration of gravel or coarser fragments (1/8 – 3/4 inch) that remains on the soil surface after finer particles have been removed by running water or wind.

FORAGE: Browse and herbage that is available and may provide food for grazing or browsing animals, or be harvested for feeding.

FORB: Any herbaceous plant other than those in the grass (Poaceae), sedge (Cyperaceae) and rush (Juncaceae) families.

FREQUENCY (% Occurrence by Species): A quantitative expression of the presence or absence of individuals of a species in a population. It is defined as the percentage of occurrence of a species in a series of samples of uniform size.

FREQUENCY OF DEFOLIATION: The number of times forage plants are defoliated during the (actual or planned) grazing period. It depends on the plant growth rate and the length of time over which plants experience grazing within a growing season.

GROUND COVER: The percentage of material, other than bare ground, covering the soil surface. It may include organic material, such as vegetation basal cover (live and standing dead), mosses and lichens, litter, and inorganic material, such as cobble, gravel, stones and bedrock. Ground cover plus bare ground will total 100 percent.

KEY AREA: A portion of rangeland selected because of its location, grazing or browsing value, or use. It serves as a monitoring and evaluation point for range condition, trend or degree of grazing use. Properly selected key areas reflect the overall acceptability of current grazing management over the rangeland. A key area guides the general management of the entire area of which it is a part.

KEY SPECIES: 1. Forage species whose use serves as an indicator to the degree of use of associated species. In many cases, key species include indicator species, and species traditionally referenced as increasers, decreasers, desirables or intermediates. 2. Those species that must, because of their importance, be considered in the management program.

LITTER: Uppermost layer of organic debris on the soil surface; essentially freshly fallen or slightly decomposed vegetative material.

MONITORING: Monitoring is the orderly collection, analysis and interpretation of resource data to evaluate progress toward meeting management objectives. This process must be conducted over time to determine whether or not management objectives are being met.

OBJECTIVE: A clear, quantifiable statement of planned results to be achieved within a stated time period. An objective is achievable, quantifiable and explicit. The completion of an objective must occur within a stated time frame, and the results must be documented.

PERCENT USE: The percentage of current year's forage production that is consumed or impacted by grazing animals. May refer to a single species or to a plant community.

PHOTO POINT: A permanently identified point from which photographs are taken at periodic intervals. Sometimes called a camera point.

PRODUCTIVITY: The rate of production per unit area, usually expressed in terms of weight or energy.

SOIL/SITE STABILITY: The capacity of a site to limit redistribution and loss of soil resources (including nutrients and organic matter) by wind and water (one of the three attributes of rangeland health).

STREAMSIDE: Often, this is where the Greenline occurs. The Greenline is the first line of perennial vegetation that forms a lineal grouping of community types (at least six inches wide and a step long) on or near the low water edge. Where there is no Greenline (such as on a bare bank), the streamside to be monitored is between the high-flow water edge and the low-flow water edge; or is often at the water edge.

STRUCTURE: It is a vertical and horizontal distribution of vegetation in an area (how the vegetation is arranged in a 3-D space). Measurements generally look at the vertical distribution by either estimating the cover of each layer or by measuring the height of the vegetation.

TRANSECT: A linear plot, usually represented by a line, along which are often placed regularly-paced plot frames, loops or other devices. (Note: Throughout this guidebook, transects are a common tool used for both long and short-term monitoring as monitoring at a given benchmark or key area usually takes place along a transect.)

TREND: The direction of change in an attribute as observed over time.

UTILIZATION: The proportion or degree of the current year's forage production that is consumed or destroyed by animals (including insects). The term may refer either to a single plant species, a group of species, or to the vegetation community as a whole. Utilization is synonymous with use.

Photo guide for "even" utilization

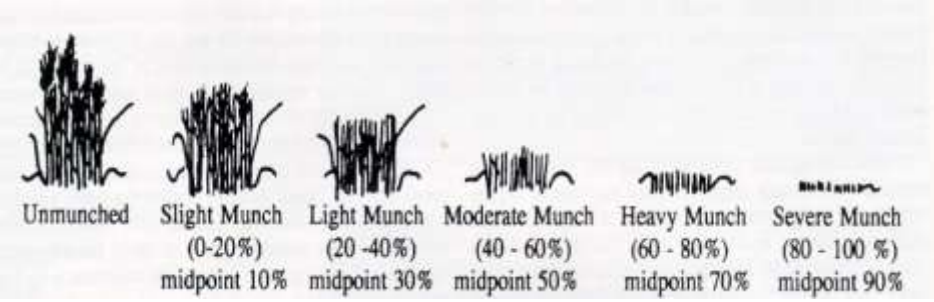
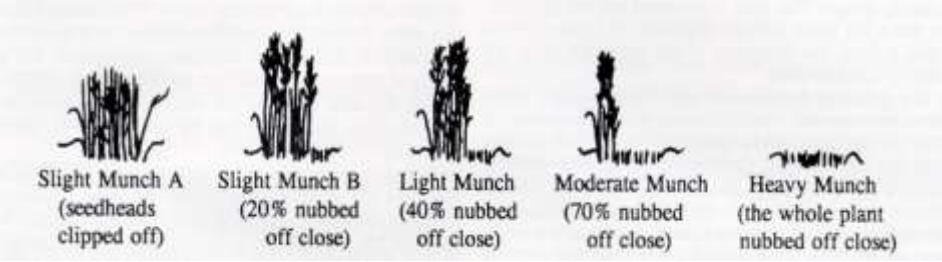


Photo guide for "uneven" utilization



VIGOR: The relative robustness of a plant in comparison to other individuals of the same species. It is reflected primarily by the size of a plant and its parts in relation to its age and the environment in which it is growing.

AGENCY AND ORGANIZATION CONTACTS

For more information on the Colorado Rangeland Monitoring Guide guidebook, for more Colorado Resource Monitoring Initiative information or to schedule a Colorado Resource Monitoring Initiative Workshop, contact the Colorado Cattlemen's Association.

Colorado Cattlemen's Association
8833 Ralston Road
Arvada, CO 80002
Phone: (303) 431-6422
Fax: (303) 431-6446
crmi@coloradocattle.org
http://www.coloradocattle.org/crmi.aspx

Additional Colorado Rangeland Monitoring Guidebook and Colorado Resource Monitoring Initiative Informational Sources:

Bureau of Land Management
2850 Youngfield Street
Lakewood, CO 80215-7093
Phone: (303) 239-3700
www.blm.gov/co/st/en.html

Colorado Association of Conservation Districts
P.O. Box 4138
Woodland Park, CO 80866
Phone: (719) 322-5232
www.cacd.us

Colorado Division of Parks and Wildlife
6060 Broadway
Denver, CO 80216
Phone: (303) 297-1192
www.wildlife.state.co.us

Colorado Grazing Lands Conservation Initiative
(Administered by the Natural Resources Conservation Service)

Colorado Public Lands Council
(Administered by the Colorado Cattlemen's Association and the Colorado Wool Growers)

Colorado State Land Board
1127 Sherman Street
Suite 300
Denver, CO 80203
Phone: (303) 866-3454
www.trustlands.state.co.us

Colorado State University Extension
Campus Delivery 4040
Fort Collins, CO 80523-4040
Phone: (970) 491-6281
www.ext.colostate.edu

Natural Resources Conservation Service
Colorado State Office
Denver Federal Center
Building 56, Room 2604
P.O. Box 25426
Denver, CO 80225-0426
Phone: (720) 544-2810
www.co.nrcs.usda.gov

United States Forest Service
Rocky Mountain Region
740 Simms Street
Golden, CO 80401
Phone: (303) 275-5350
www.fs.fed.us/r2