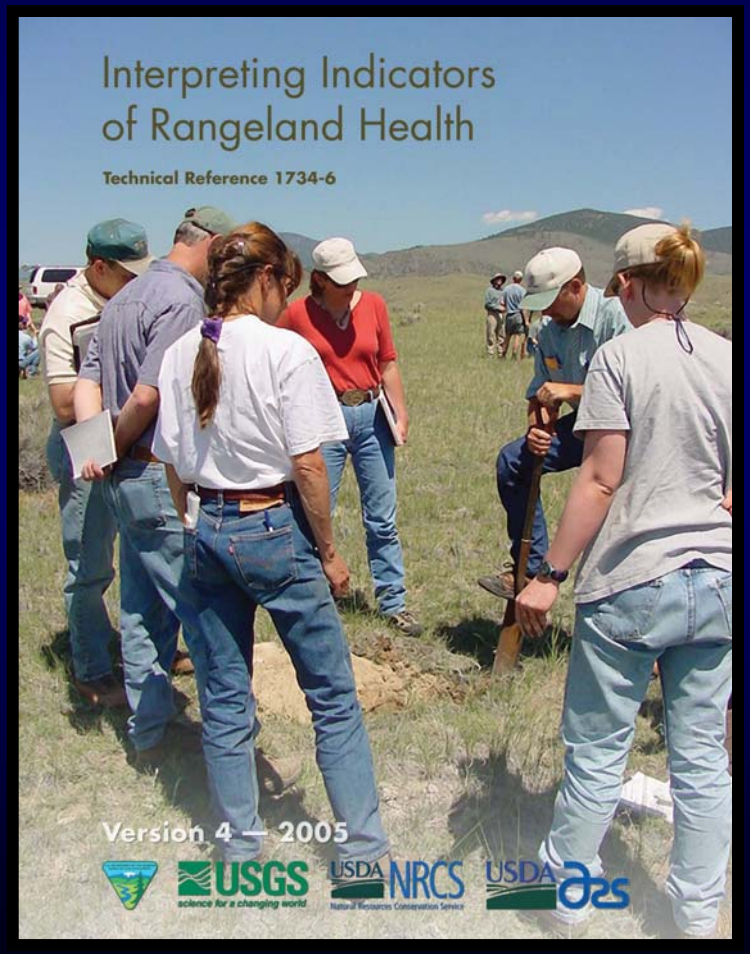
Introduction to Interpreting & Measuring Indicators of Rangeland Health

Worland, WY --- June 2008

- Background on the development of IIRH
- Definitions
- Applications

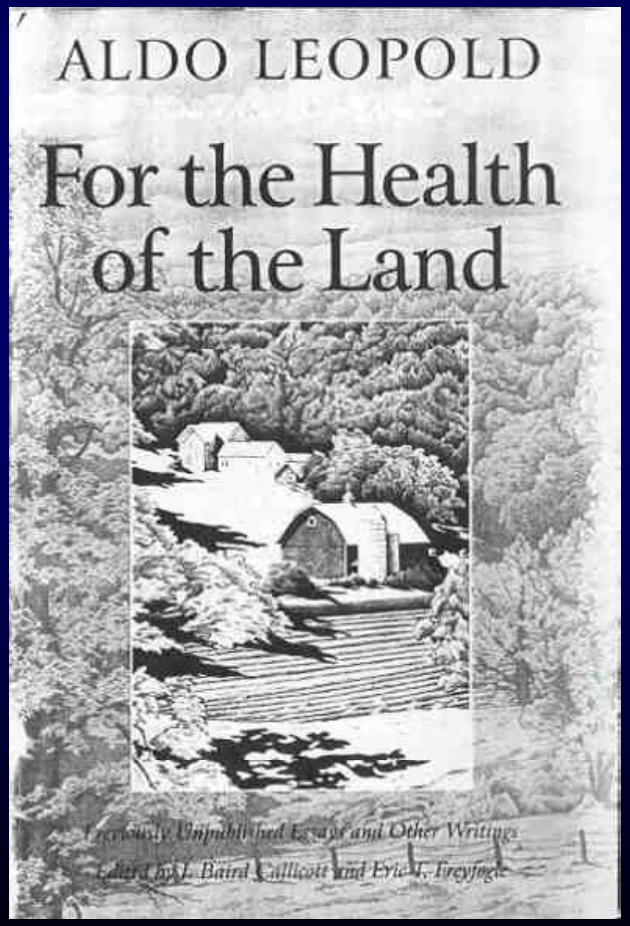


"The Land Health Concept and Conservation" (1946)

"The capacity for self-renewal in the biota."

Symptons of "Land Sickness"

- Abnormal erosion
- Decline of yields
- Shortening of species lists
- Dominance of plant weeds

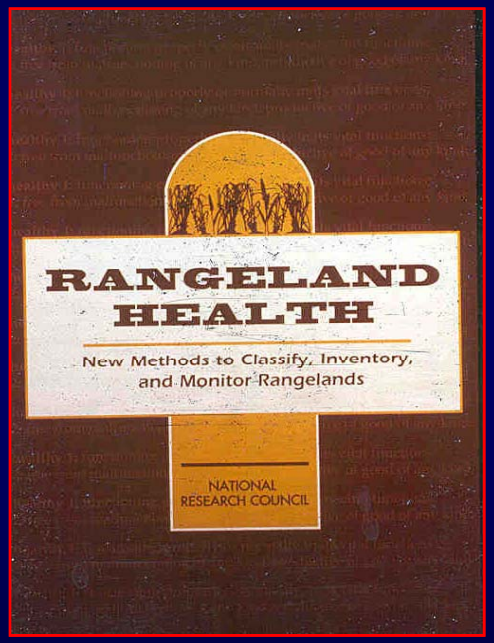


Use of Qualitative Protocols and Indicators

- Parker Three-step (BLM & Forest Service-1950's)
- Phase I Watershed Inventory (1970's)- "Soil Surface Factors"
- Riparian Proper Functioning Condition (1990's)

National Research Council- 1994

- Evaluated current and historic agency monitoring and inventory procedures
- Recommended improvements (e.g., rangeland health matrix) to better characterize health of rangelands



Interagency Version 1-2 Protocols 1995-2000

Biotic Environment Worksheet

Relative to Ecological Reference Area(s)-ERA

Indicator	Similar to ERA(s)	Marginally Similar to ERA(s)	Dissimilar to ERA(s)

Physical Environment Worksheet

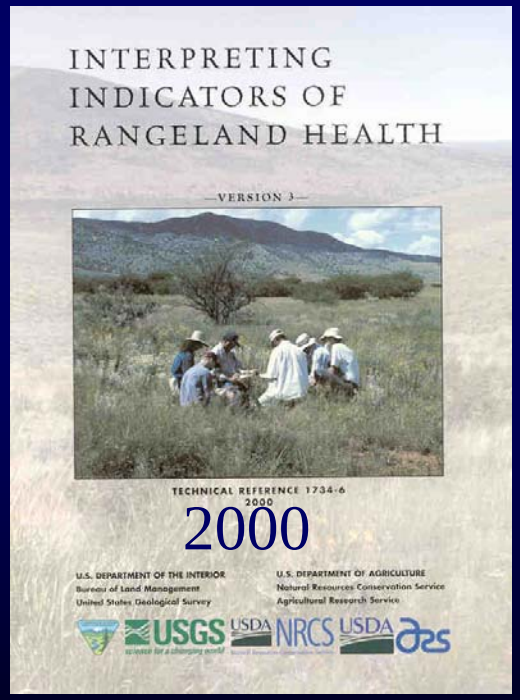
Relative to Ecological Reference Area(s)-ERA

Indicator	Similar to ERA(s)	Marginally Similar to ESA(s)	Dissimilar to ESA(s)
1. Flow Patterns	Few, slight deposition	Well defined, small with intermittent deposits	Numerous with soil deposits common
2. Surface Litter	In place or slight movement	Moderate movement, bigger litter displaced	Extreme movement, occurs with each event
3. Soil Movement - Water	None to slight	Moderate, slight terracing & some short pedastals	Significant movement with each event, rocks and plants on pedastals, some roots exposed
4. Soil Movement- Wind	None to slight	Wind scoured depressions evident, small aeolian deposits around plant clumps	Wind scoured depressions common with large aeolian deposits around plant clumps
5. Soil Crusting & Surface Sealing	None to minimal with "soft" physical and/or chemical crusts	Physical and/or chemical crusting obvious with reduced infiltration occurring	Hard physical and chemical crusts widespread on bare ground, strongly reducing infiltration
6. Compaction Layer	None to minimal, not restrictive	Thin, weakly restrictive to roots and water	Extensive with > 1" width, strongly restrictive
7. Rills	If present, rare and widely spaced	Occasionally present, < 3" deep	Very common at 5' or less intervals, up to 6" deep
8. Gullies	None to few, if present gullies are healing (veg. on sides & bottom	Few present, active erosion (incised sides) on <10% of length	Numerous with active erosion on 20% or more of length, some headcutting evident
9. Cover- Amount (veg, litter, rock etc.)	Adequate (> %) to protect site from accelerated erosion.	Marginal (around %) for site protection, accelerated erosion starting	Inadequate (> %) for site protection, accelerated erosion evident
10. Cover- Distribution	Well distributed with bare ground areas small	Bare ground areas larger, more numerous and less uniform in distribution	Bare ground areas numerous over large areas, most cover is under trees or shrubs, if present

Current site--->	XXXXX	XXX	X XX
ERA(s)-------->			

Rating: 1.Functioning___ 2.At Risk____ 3. Improperly Functioning: a) Reversible____ b) Irreversible____

Interpreting Indicators of Rangeland Health-Version 3



2000

1999 Peer Review

Interpreting Indicators of Rangeland Health-Version 4

J. Range Manage.
55:584-597 November 2002

Rangeland health attributes and indicators for qualitative assessment

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Abstract

Panels of experts from the Society for Range Management and the National Research Council proposed that status of rangeland ecosystems could be ascertained by evaluating an ecological site's potential to conserve soil resources and by a series of indicators for ecosystem processes and site stability. Using these recommendations as a starting point, we developed a rapid, qualitative method for assessing a moment-in-time status of rangelands. Evaluators rate 17 indicators to assess 3 ecosystem attributes (soil and site stability, hydrologic function, and biotic integrity) for a given location. Indicators include rills, water flow patterns, pedestals and terracettes, bare ground, gullies, wind scour and depositional areas, litter movement, soil resistance to erosion, soil surface loss or degradation, plant composition relative to infiltration, soil compaction, plant functional/structural groups, plant mortality, litter amount, annual production, invasive plants, and reproductive capability. In this paper, we detail the development and evolution of the technique and introduce a modified ecological reference worksheet that documents the expected presence and amount of each indicator on the ecological site. In addition, we review the intended applications for this technique and clarify the differences between assessment and monitoring that lead us to recommend this technique be used for moment-in-time assessments and not be used for temporal monitoring of rangeland status. Lastly, we propose a mechanism for adapting and modifying this technique to reflect improvements in understanding of ecosystem processes. We support the need for quantitative measures for monitoring rangeland health and propose some measures that we believe may address some of the 17 indicators.

Key Words: Soil stability, hydrologic function, biological integrity, ecosystem status, erosion, infiltration, inventory

Resumen

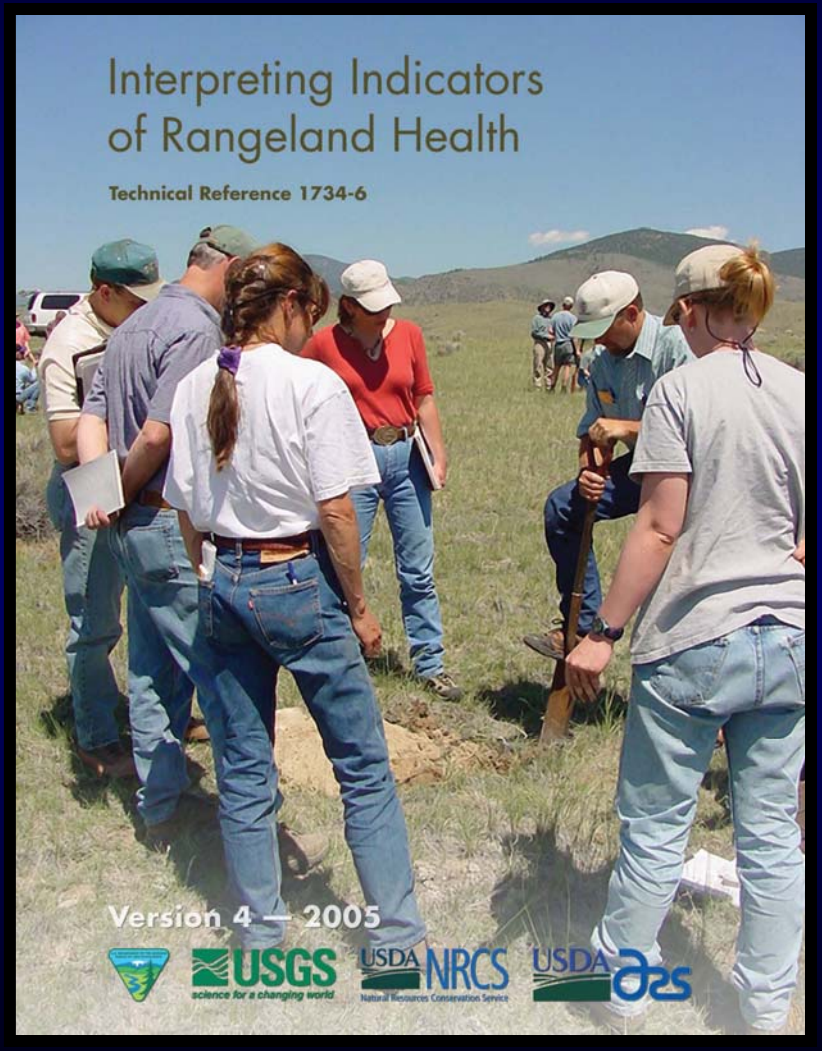
Un panel de expertos de la "Society for Range Management" y el "National Research Council" propusieron que el estado de los ecosistemas de los agostaderos podría ser determinado evaluando el potencial que un sitio ecológico tiene para conservar recursos del suelo, y por una serie de indicadores de procesos ecológicos y estabilidad del sitio. Utilizando estas recomendaciones como punto de partida, desarrollamos un rápido método cualitativo para evaluar el estado de agostaderos en un punto específico en el tiempo. Se evaluaron 17 indicadores para asesorar 3 atributos del ecosistema (suelo y estabilidad del sitio, función hidrológica, e integridad biótica) para un sitio específico. Estos indicadores incluyen riachuelos (canalillos), patrones de escurrimiento, pedestales y terracetas, suelo desnudo, quebradas (cárcavas), erosión eólica y áreas de deposición, movimiento de mantillo, resistencia del suelo a la erosión, degradación o perdida de la superficie del suelo, composición vegetal con relación a la infiltración, compactación del suelo, grupos vegetales funcionales y estructurales, mortalidad vegetal, cantidad de mantillo, producción anual, plantas invasivas, y capacidad de reproducción. En este informe, detallamos el desarrollo y evolución de esta técnica. También introducimos una tabla de datos de referencia ecológica modificada que documenta la presencia esperada y la cantidad de cada indicador en el sitio ecológico. En adición, repasamos las aplicaciones apropiadas para esta técnica y clarificamos las diferencias entre evaluación y monitoreo que nos llevaron a recomendar que esta técnica deberá ser utilizada para evaluación de un punto en el tiempo, y no para un monitoreo temporal de el estado de agostaderos. Por ultimo, recomendamos un mecanismo para adaptar y modificar esta técnica para reflejar mejoramientos y entendimiento de los procesos de ecosistemas. Soportamos la necesidad de medidas cuantitativas para el monitoreo de salud de los agostaderos, por lo cual proponemos algunas medidas que creemos que pueden tomarse en cuenta para algunos de los 17 indicadores.

BLM, NRCS, USGS and ARS jointly funded this project. Authors wish to thank Drs. B. Bestelmeyer, J. Alexander, L. Eddleman, M. Karl, W.C. Krueger, M. Rodhmann, W. Laycock, M. Miller, P. Sims, F.L. Smith, T. Stohlgren, S. Swanson, G. Tanner, T. Thurow, J. Trlica, various BLM and NRCS staff, the Association of Rangeland Consultants, Western Coordinating Committee on Rangeland Ecological Research & Assessment for helpful input that improved this technique. G. Frasier and three anonymous reviewers for their critical comments that improved this manuscript; D. Toledo and A. Melgoza for drafting the Spanish version of the abstract.

Manuscript accepted 6 Mar. 2002.

Rangeland assessments in the United States over the past century have relied heavily on the Clementsian view of plant succession that plant communities progress or regress along predictable courses of defined communities in response to changes in disturbance or environmental regimes, including grazing and precipitation (Clements 1920, Dyksterhuis 1949). Rangeland scientists and managers have increasingly questioned the appropriateness

2001 Peer Review



2005 Interagency TR

Changes from Version 3.0 to 4.0 (Page iii)

1) Reference Sheet
2) Evaluation matrices are ecological site-specific
3) Litter Movement indicator moved from Hydrologic Function to Soil/Site Stability Attribute
4) Added Quantitative/Qualitative linkages
5) Revised worksheets to improve usability.

Changes from Version 3.0 to 4.0

Reference Sheet now used to integrate and document *all* sources of reference information (pages 74-75).

Reference Sheet (Standard Example)

Author(s)/participant(s): Winnemucca Class Participants (May 12-15, 2005)

Contact for lead author: _____ **Reference site used?** Yes

Date: 5/11/05 **MLRA:** 024XY **Ecological Site:** Loamy 8-10" PZ, 024XY005NV. This *must* be verified based on soils and climate (see Ecological Site Description). Current plant community cannot be used to identify the ecological site.

Composition (indicators 10 and 12) based on: X Annual Production, __Foliar Cover, __Biomass

Indicators. For each indicator, describe the potential for the site. Where possible, (1) use numbers, (2) include expected range of values for above- and below-average years for **each** community and natural disturbance regimes within the reference state, when appropriate and (3) cite data. Continue descriptions on separate sheet.

1. Number and extent of rills: Minimal on slopes less than 10% and increasing slightly as slopes increase up to 50%. Rills spaced 15-50 feet apart when present on slopes of 10-50%. After wildfires, high levels of natural herbivory or extended drought, or combinations of these disturbances, rills may double in numbers on slopes from 10-50% after high intensity summer thunderstorms.

2. Presence of water flow patterns: Generally up to 20 feet apart and short (less than 10 feet long) with numerous obstructions that alter the water flow path. On slopes of 10-50%, flow patterns increase in number and length. Flow pattern length and numbers may double after wildfires, high levels of natural herbivory, extended drought, or combinations of these disturbances if high intensity summer thunderstorms occur.

3. Number and height of erosional pedestals or terracettes: Plant or rock pedestals and terracettes are almost always in flow patterns. Wind caused pedestals are rare and only would be on the site after wildfires, high levels of natural herbivory, extended drought, or combinations of these disturbances. Pedestals of Sandberg bluegrass on pedestals outside water flow patterns are generally caused by frost heaving, not erosion. Pedestals and terracettes would be particularly apparent on 10-50% slopes, especially immediately after high intensity summer thunderstorms.

Changes from Version 3.0 to 4.0

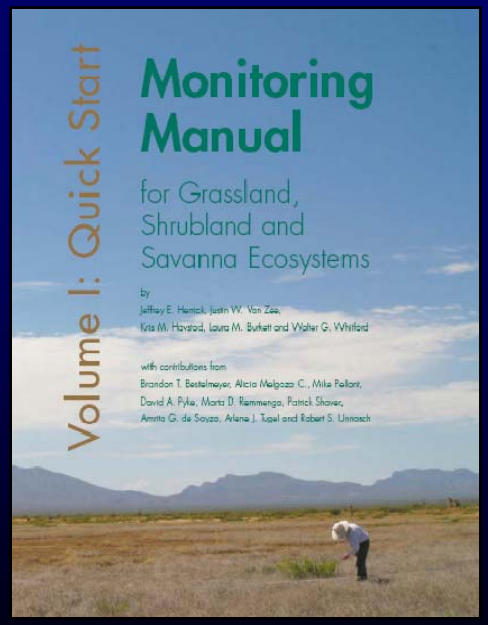
Ecological site-specific evaluation matrices strongly recommended (Page 25)

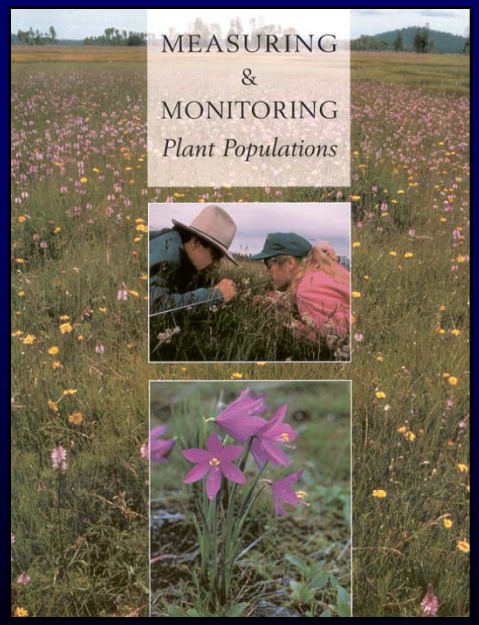
	Departure from Reference Sheet				
Indicator	**Extreme to Total**	**Moderate to Extreme**	**Moderate**	**Slight to Moderate**	**None to Slight**
4. Bare ground	Greater than 75% bare ground with entire area connected. Only occasional areas where ground cover is contiguous, mostly patchy and sparse.	60-75% bare ground. Bare patches are large (>24" diameter) and connected. Surface disturbance areas becoming connected to one another. Connectivity of bare ground broken occasionally by contiguous ground cover.	45-60% bare ground with much connectivity especially associated with surface disturbance.Individual bare spaces are large and dominate the area.	30-45% bare ground. Bare spaces greater than 12" diameter and rarely connected. Bare areas associated with surface disturbance are larger (> 15") and may be connected to other bare patches.	**Reference Sheet:** 20-30% bare ground; bare patches should be less than 8-10' diameter and not connected; occasional 12' patches associated w/shrubs. Larger bare patches also associated with ant mounds and small mammal disturbances.
Generic Descriptor	Much higher than expected for the site. Bare areas are large and generally connected.	Moderate to much higher than expected for the site. Bare areas are large and occasionally connected.	Moderately higher than expected for the site. Bare areas are of moderate size and sporadically connected.	Slightly to moderately higher than expected for the site. Bare areas are small and rarely connected.	Amount and size of bare areas match that expected for the site.

Changes from Version 3.0 to 4.0

Added Quantitative/Qualitative Linkages (page 112)

Indicator	Quantitative Indicator	Measurement (References)	Interpretation
Bare Ground	% Bare Ground	Line Point Intercept (Monitoring Manual and Measuring & Monitoring Plant Populations)	Bare ground is positively correlated with runoff and erosion





Terminology

- Inventory
- Monitoring
- Assessment

Inventory

The systematic acquisition and analysis of resource information needed for planning and management. This information is generally not collected as frequently as monitoring data.

Monitoring

The orderly and quantitative collection, analysis and interpretation of resource data to evaluate progress (trend) toward meeting management objectives.

% Cover			
Attribute	1980	1990	2000
Bare Ground	12	20	26
Live Plants (canopy)	47	34	27

Assessment

The process of estimating or judging the value or functional status of ecological processes (e.g., rangeland health). It is generally a "moment-in-time" evaluation that is not repeated in the future (not a monitoring tool).

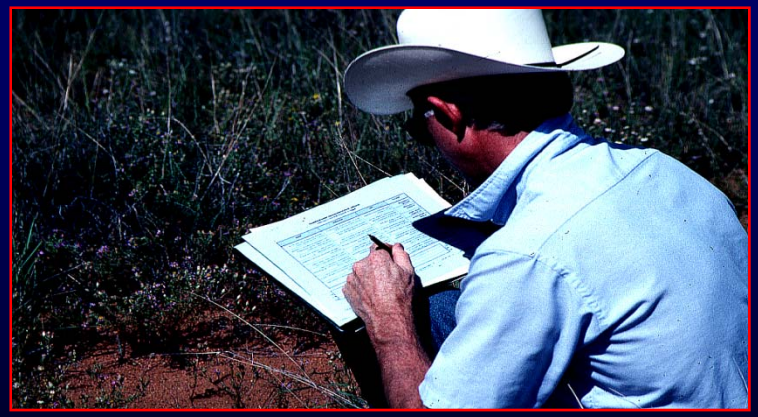
"Interpreting Indicators of Rangeland Health, Version 4"

Quantitative & Qualitative Studies

- Quantitative
  - Objective
  - Measure attributes

*"Cheatgrass cover is **85%**"*

- Qualitative
  - Observations
  - Describe or rate attributes



*"Cheatgrass is rated as **abundant**"*

Uses and Constraints

IIRH is primarily a **qualitative assessment** protocol! There are benefits in use and limitations in application:

Appropriate Applications	Limitations in Use
Initial health evaluation	Requires local experience
Identify "at risk" areas	Doesn't establish cause
Select monitoring sites	Not a stand-alone decision tool
Communication tool	Not a monitoring technique

Interpreting Indicat ors of Rangeland Health-Version 5?