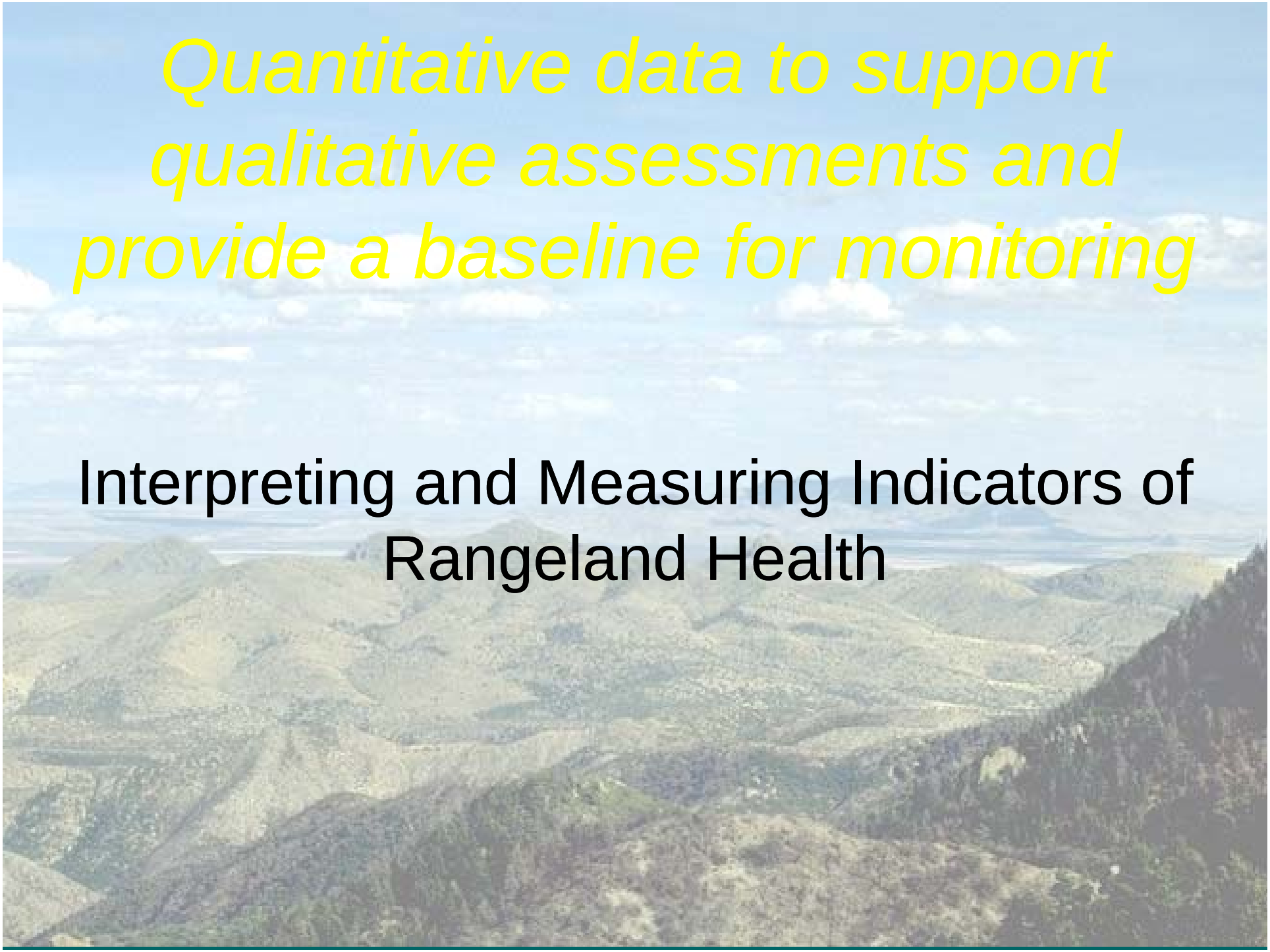


Quantitative data to support qualitative assessments and provide a baseline for monitoring

Interpreting and Measuring Indicators of Rangeland Health

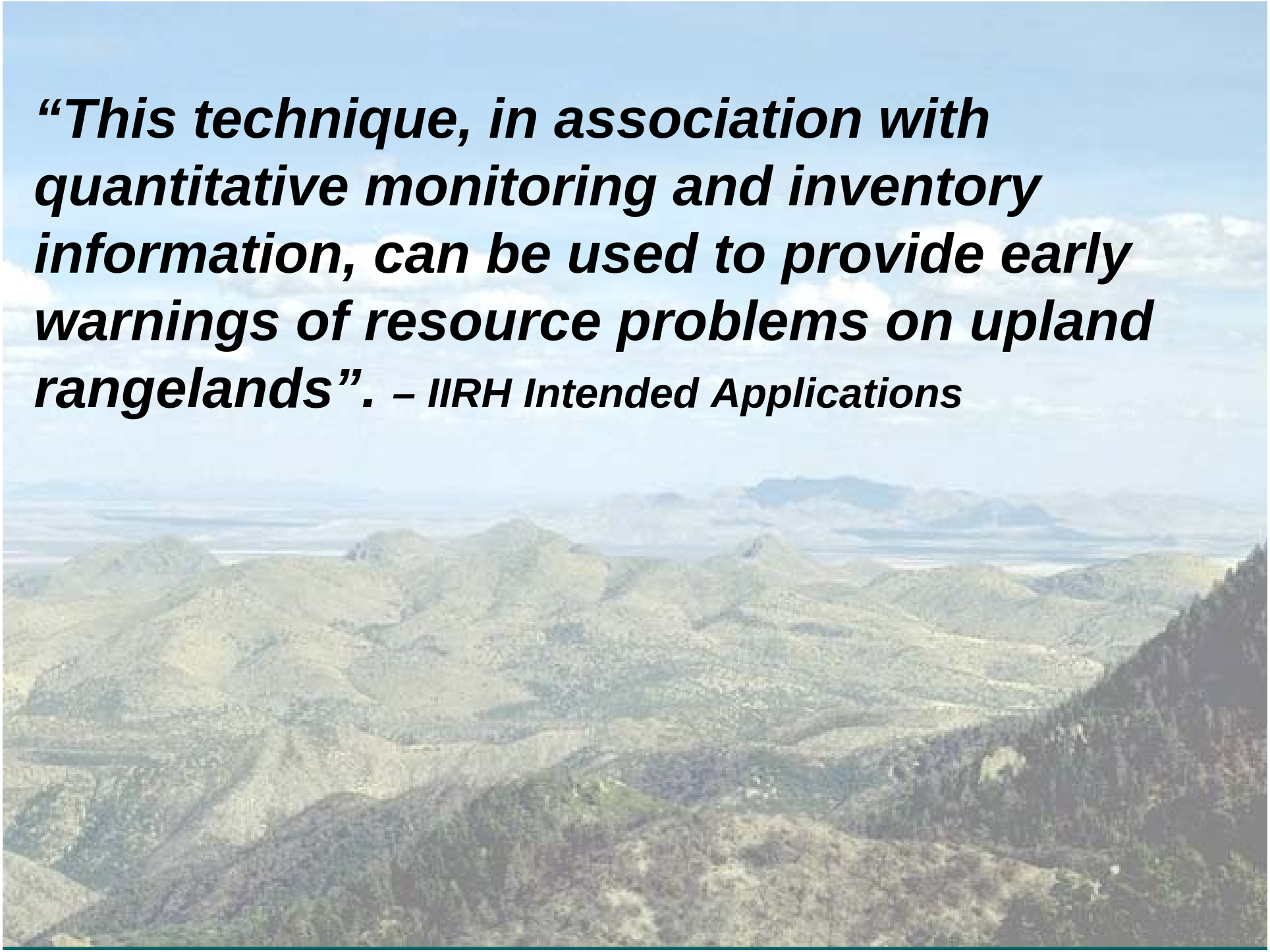
"This technique, in association with quantitative monitoring and inventory information, can be used to provide early warnings of resource problems on upland rangelands". ***– IIRH Intended Applications***

The approach is NOT to be used to:

- Identify the cause(s) of resource problems
- Independently make grazing and other management changes
- ***Monitor land or determine trend***
- Independently generate national or regional assessments of rangeland health

– ***IIRH Intended Applications***

"This technique, in association with quantitative monitoring and inventory information, can be used to provide early warnings of resource problems on upland rangelands". ***– IIRH Intended Applications***



Objectives

1. Why quantitative data?
2. Relationship to attributes and indicators
3. Accuracy and precision of qualitative and quantitative indicators
4. Static soil properties for ecological site identification AND dynamic soil properties for evaluations
5. Selected measurements (overview)

1. Why quantitative data?

- "Quantitative measurements should be made:
  - where it is necessary to document assessments
  - for direct comparisons with other locations, or
  - where monitoring data are required to determine trend".

  (IIRH Concepts section, Qualitative vs. Quantitative indicators)

2. Relationship to indicators and attributes

- "The best approach to designing a quantitative monitoring program that is compatible with this qualitative assessment protocol is to select the best quantitative indicators for each of the three *attributes,* rather than selecting an equivalent quantitative indicator for each qualitative indicator".

  (IIRH Concepts section, Qualitative vs. Quantitative indicators)

3. Accuracy and precision of qualitative & quantitative indicators

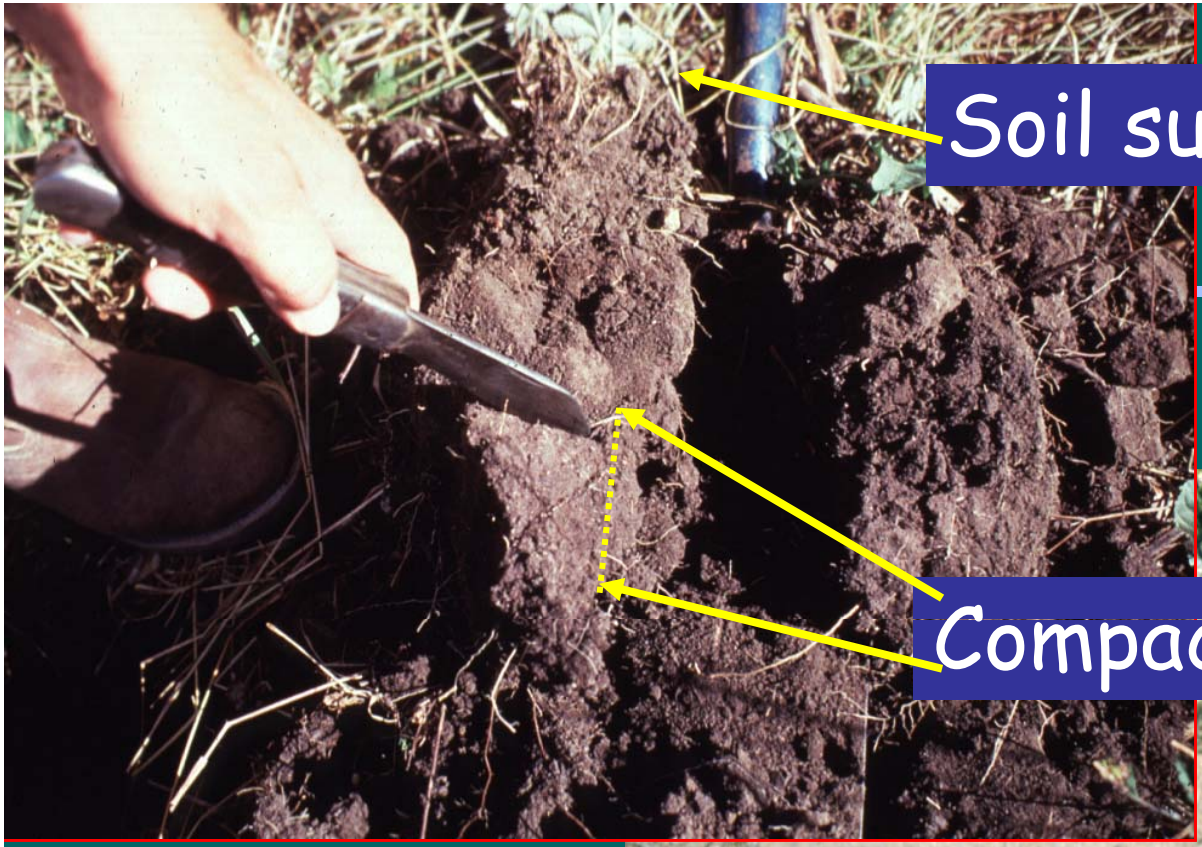
- Quantitative are more ***precise***

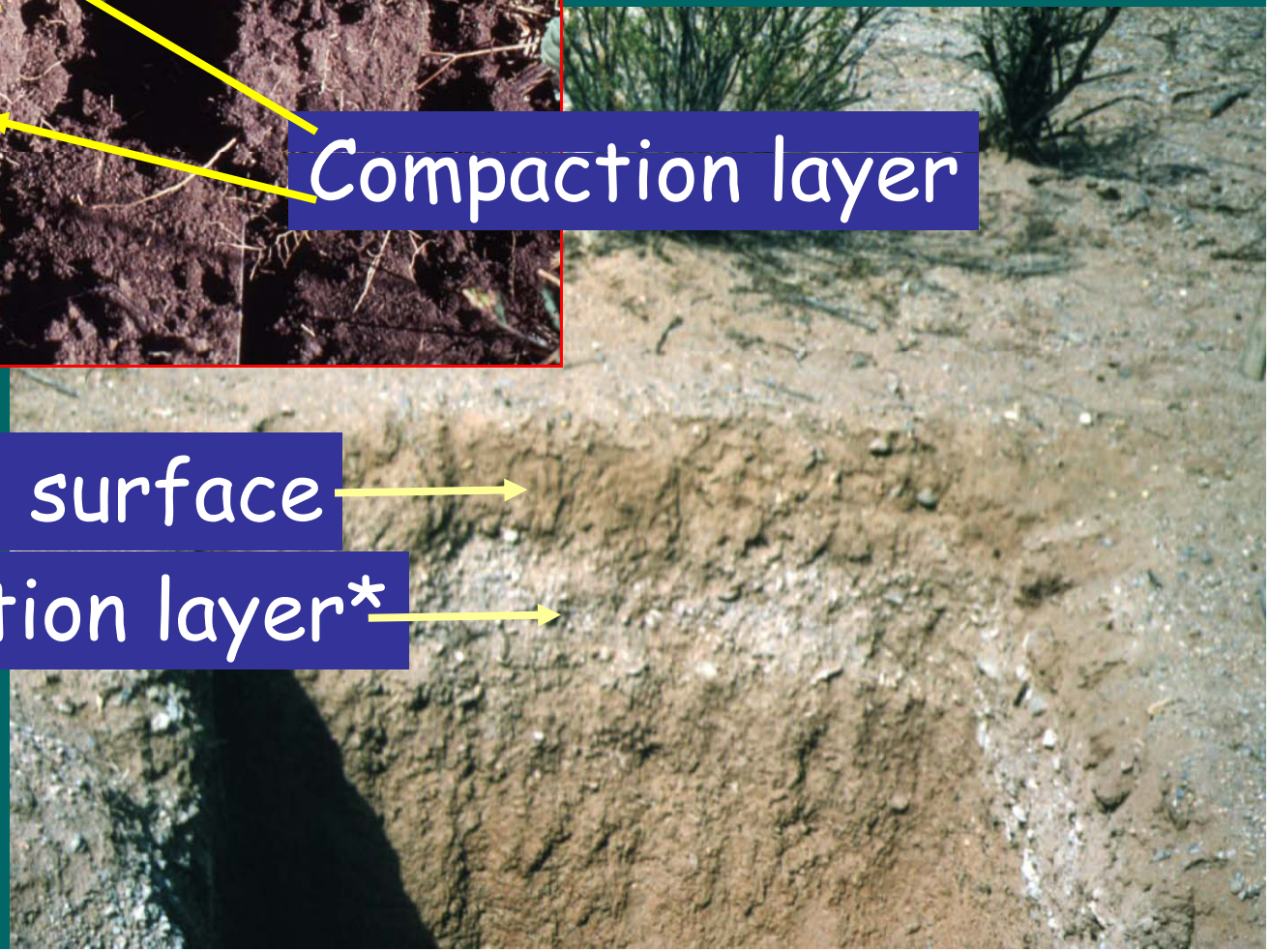
- Either qualitative OR quantitative can be more ***accurate***

Recent Research: qualitative indicators ***can*** *be as accurate as quantitative*

- **Watters, Weltz, and Smith (1996)**
  - Standing biomass, basal cover, nearest pern. plant, and freq. with no rooted plant showed strong relationships to the *subjective* Site Stability Rating.
- **Lane, Nichols, and Levick (1999)**
  - Verified qualitative Soil/Site Stability indicators with quantitative data.
  - "range health assessment methodology is a significant advance over previous…procedures.."
- **Liebig & Doran (1999)**
  - Farmers perceptions of soil quality were closely related to most lab results…useful screen for further evaluations.

*Some qualitative indicators **can** be MORE accurate (or at least more informative) than quantitative*





*Even though it has a high (quantitative) bulk density

4. (Relatively) static vs. Dynamic Soil Properties

What’s the difference?

Why do we care?

(Relatively) static vs. dynamic soil properties

- (Relatively) static properties:
  - are used to define soil series (and therefore ecological sites)
  - change little in response to differences in management and vegetation
- Dynamic properties:
  - are used to define the relative condition of the soil
  - change in response to differences in management
  - are related to changes in erodibility, infiltration, nutrient availability, etc...

Factors associated with (relatively) static vs. dynamic soil properties

- (Relatively) static properties associated with:
  - parent material and soil profile development (mineralogy, depth, texture)
  - landscape position (long-term source/sink for sediment, water and nutrients)
- Dynamic properties associated with:
  - vegetation
  - soil biotic activity (from bacteria to badgers)
  - above-ground disturbance and short-term erosion/deposition (surface texture, infiltration capacity, microbiotic crusts)

(Relatively) static soil properties are used to identify ecological sites

- Soil depth
- Soil texture by depth
- Stoniness
- Type of clay (cracking vs. non-cracking)

Why dynamic soil properties?

- Additional information on current and future condition
- Possible early-warning indicators of changes in plant community
  - Microsite conditions for regeneration
  - Alteration of resource supply capacity
    - » Spatial and temporal distribution of resources
    - » Change in processes responsible for nutrient cycling and energy flow
  - Changes in root environment

"If one agrees that a variety of current and potential plant communities can occur above a conservation threshold for a particular ecological site, then monitoring vegetation has to take a backseat to monitoring soils."

-- Neil West, Kirk McDaniel, E. Lamar Smith, Paul Tueller and Steve Leonard. 1994. Monitoring and Interpreting Ecological Integrity of Arid and Semi-Arid Lands of the Western United States. New Mexico Range Improvement Task Force.

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Problem: few reliable, rapid field indicators have been tested on rangelands

5. Selected measurements (overview)

IIRH Table 7

- USDA 1997 (NRCS Pasture & Range Handbook)
- Elzinga et al. 1998 (Measuring & Monitoring Plant Populations)
- Herrick et al. 2004 (Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems)

Also
NARSC 1996
NRCS Soil Quality Institute 2002

See also Appendix 7 for indicator-specific comparisons

Table 7

Attribute	Qualitative assessment indicators	Key quantitative assessment indicators	Selected measurements and references
Soil and site stability	•Rills •Water flow patterns •Pedestals/terracettes •Bare ground •Gullies •Litter movement •Wind-scoured, blowouts and/or deposition areas •Soil surface resistance to erosion •Soil surface loss or degradation •Compaction layer •Litter amount	Bare ground	Line point intercept (2, 3) Point frame (2)
		Proportion of soil surface covered by canopy gaps longer than a defined minimum	Canopy gap intercept (3) Continuous line intercept (2)
		Proportion of soil surface covered by basal gaps longer than a defined minimum	Basal gap intercept (3) Continuous line intercept (2)
		Soil macroaggregate stability in water	Soil stability kit (3)

1. USDA 1997 (NRCS Pasture & Range Handbook)
2. Elzinga et al. 1998 (Measuring & Monitoring Plant Populations)
3. Herrick et al. 2005 (Monitoring Manual for Grassland/Shrubland/Savanna Ecosystems)

Scientific Literature

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→

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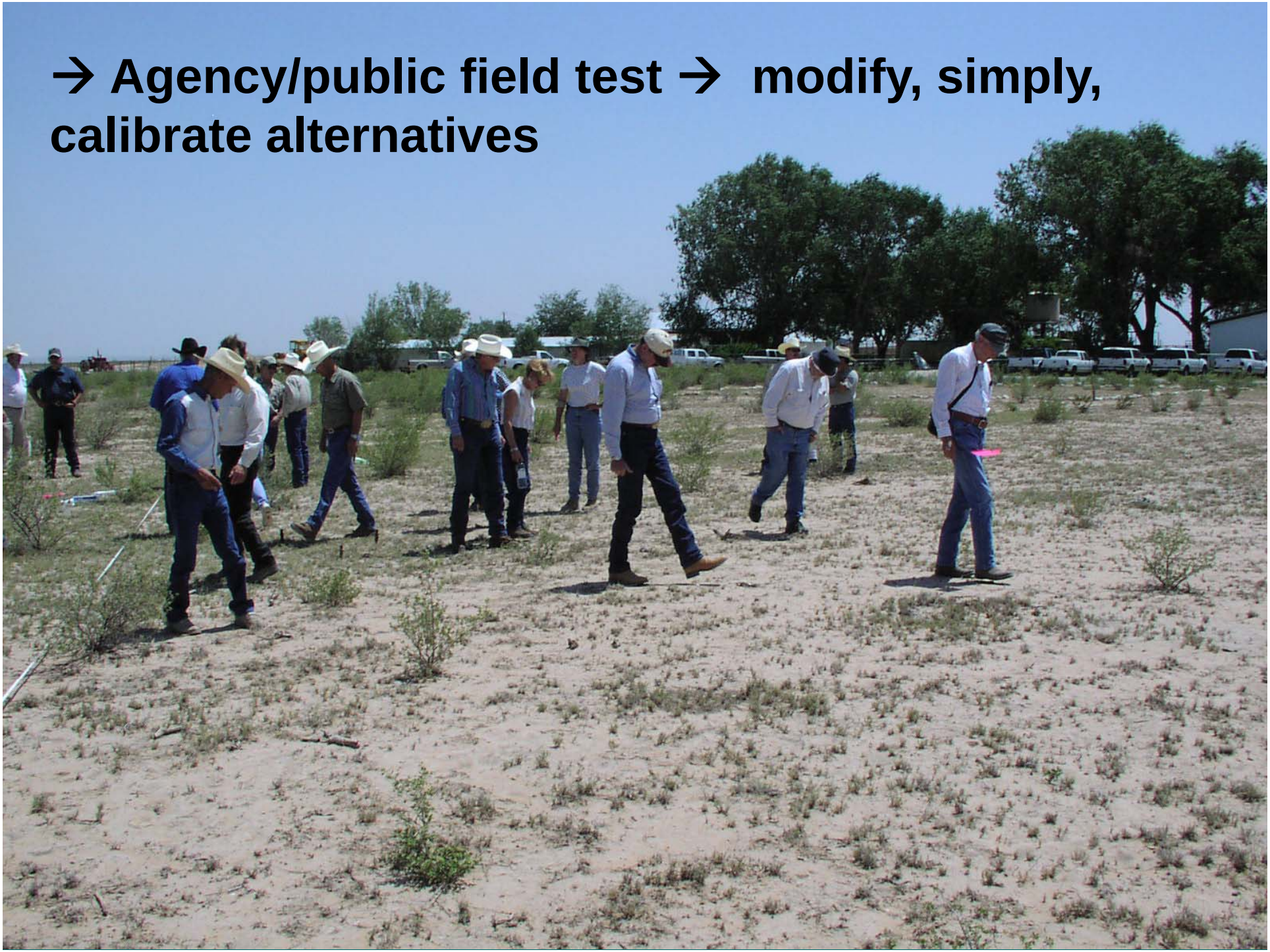
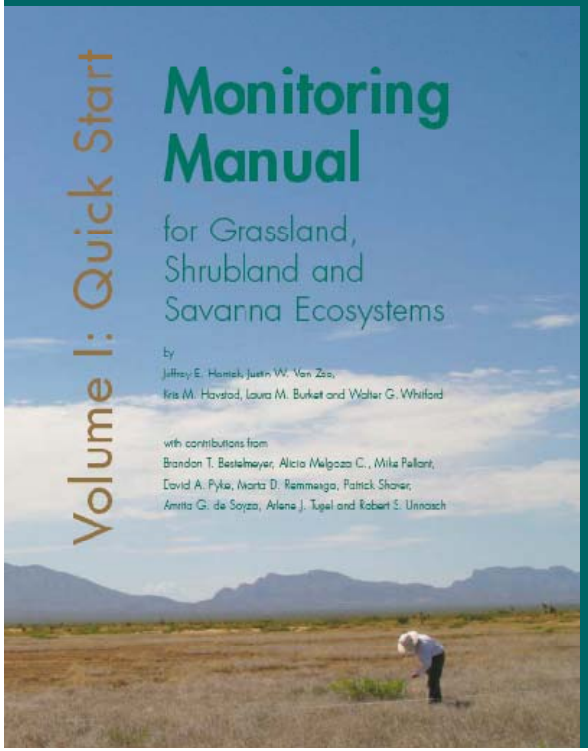
→ Agency/public field test → modify, simply, calibrate alternatives



Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems

- *Soil & site stability*
- *Hydrologic function*
- *Biotic integrity*



- **Recreation**
- **Wildlife habitat**
- **Invasive species**
- **Riparian management**
- **Military land management**

Foundation

Soil & Site Stability	**Hydrologic Function**	**Biotic Integrity**

Basic measurements

Additional measurements

- For production (Indicator 15)
- For compaction (Indicator 11)
- For infiltration (Indicator 10)

Double sampling for production

Impact penetrometer

Cylinder infiltrometer

CRUCE DE ZORRILLOS