Dynamic Soil Properties in Soil Survey: Meeting Needs for Quality Soil Management

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Current situation:

Soil survey databases do not reflect the effects of management.

(in most cases)

Would you like information to answer questions about soil quality?

- **What is the condition of my soil (level of function; soil quality)?**
- **What can be used to detect soil degradation before it occurs?**
- **What will it take to restore or improve it? *(and how much $$$***
- **How will soil changes affect future management options?**

Soil Survey Product

- **Reference condition**
- **Early warning indicators**
- **Resistance and resilience ratings**
- **Resilience**

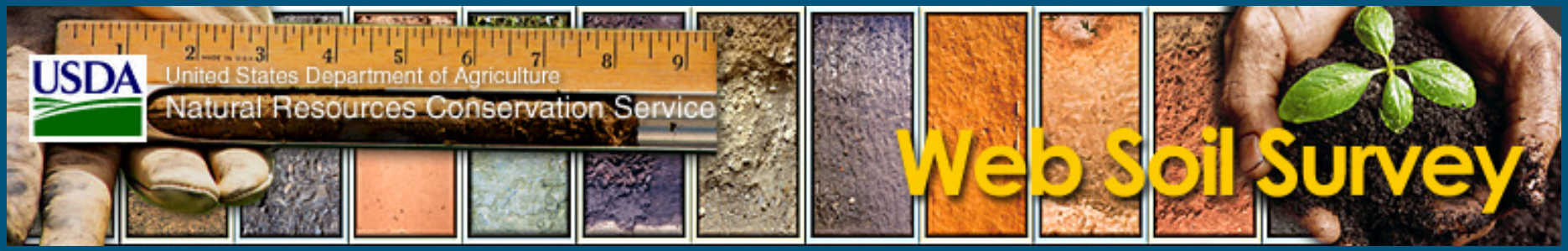
Would you like to know if the change in soil quality indicators is reversible?

Organic matter	most likely
Aggregate stability	most likely
Salinity	only with suitable outlet
Erosion	no
Mineral eCEC	not in some soils
Contaminants	some yes, some no

For a specific soil?

Soil survey mission:

"Keeping soil survey relevant to ever-changing needs and providing technical assistance".



Outline

- New soil survey objectives
- Data collection methods
- Uses of soil change data and interpretations
- Summary

Objective 1. Account for soil change over the human time scale

Richter and Markowitz, 2001
Understanding Soil Change

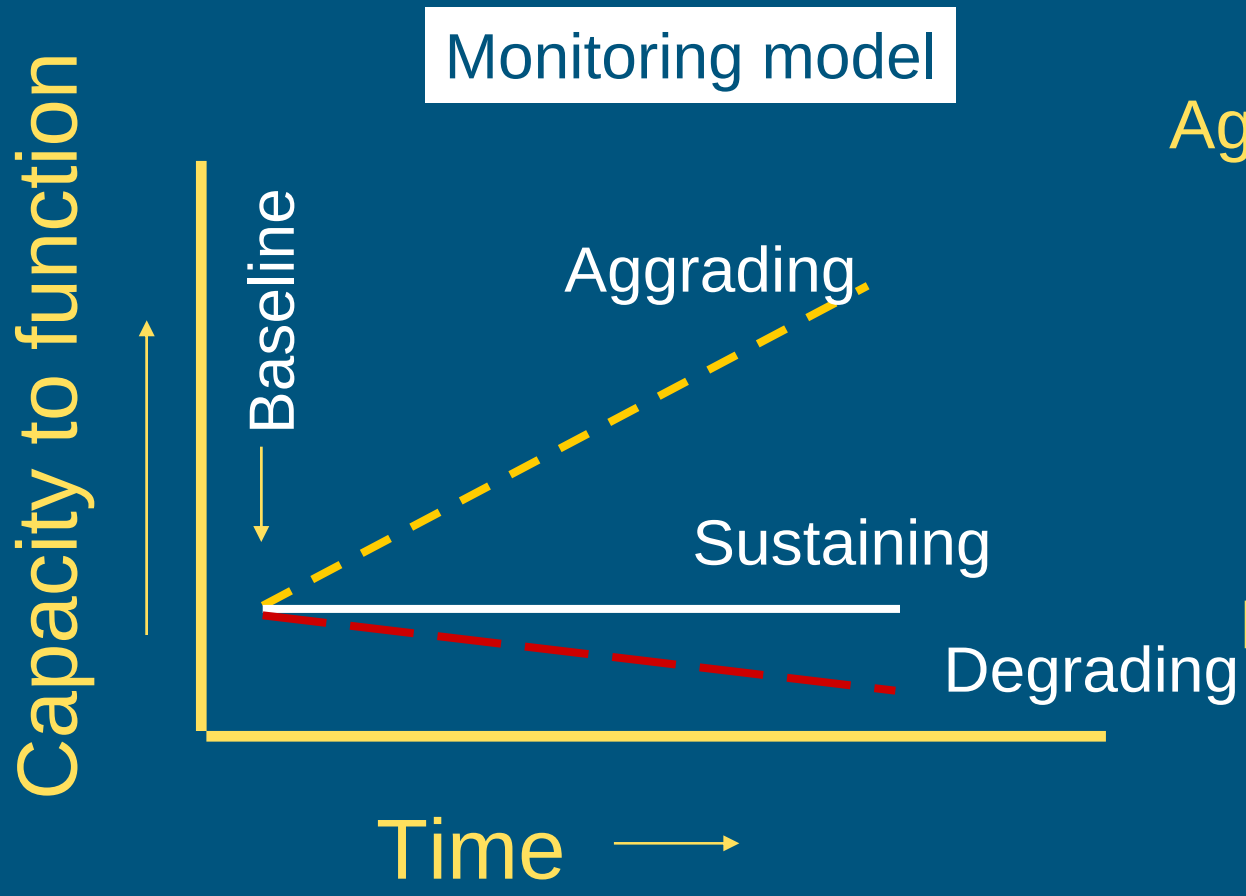
Centuries, decades and less

- Decades to centuries - the *recovery* time scale
- Decades - the *management* time scale

Tugel et al., 2005

Dynamic soil properties =

Soil properties that change over the human time scale in response to management, natural disturbances, or climate change.



Organic matter

Aggregate stability

Salinity

Infiltration

Ksat

Topsoil depth

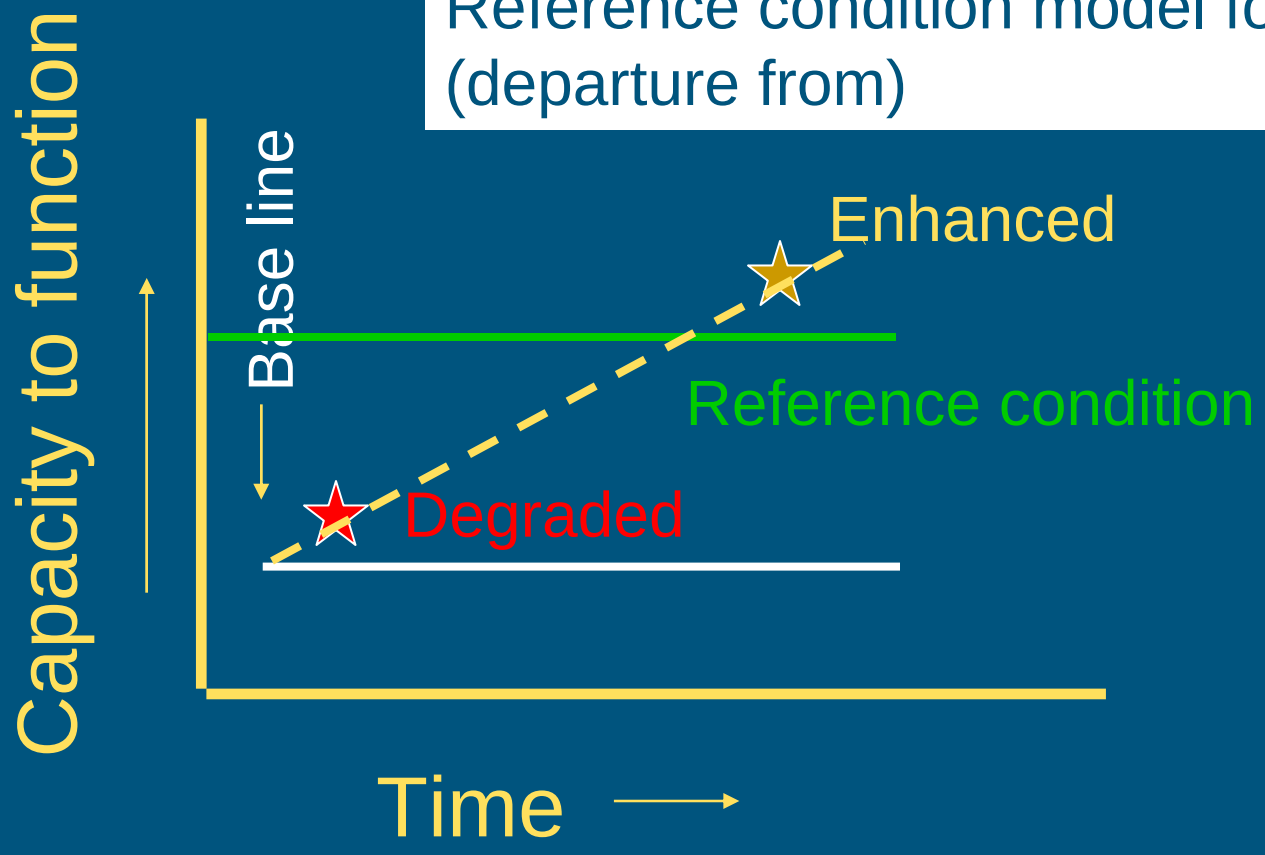
Biological crusts

etc.

Dynamic soil properties =

Soil properties that change over the human time scale.

Reference condition model for soil survey (departure from)



Objective 2. Improve accuracy of databases (and provide reference values for soil quality indicators).

Soil organic matter

Soil	Database estimate	Grassland-measured	Cultivated-measured
Askarben	2-4 %	6.0	3.0
Monona	2-4 %	3.6	2.9

(Grossman, unpublished)

- Important for C-sequestration, pesticide applications, nutrient applications

Objective 3. Develop interpretations of management effects on soil function.

- The importance of soil change is its affect on function.
- The consequences of change depend on its reversibility.

(Arnold et al.,1990)

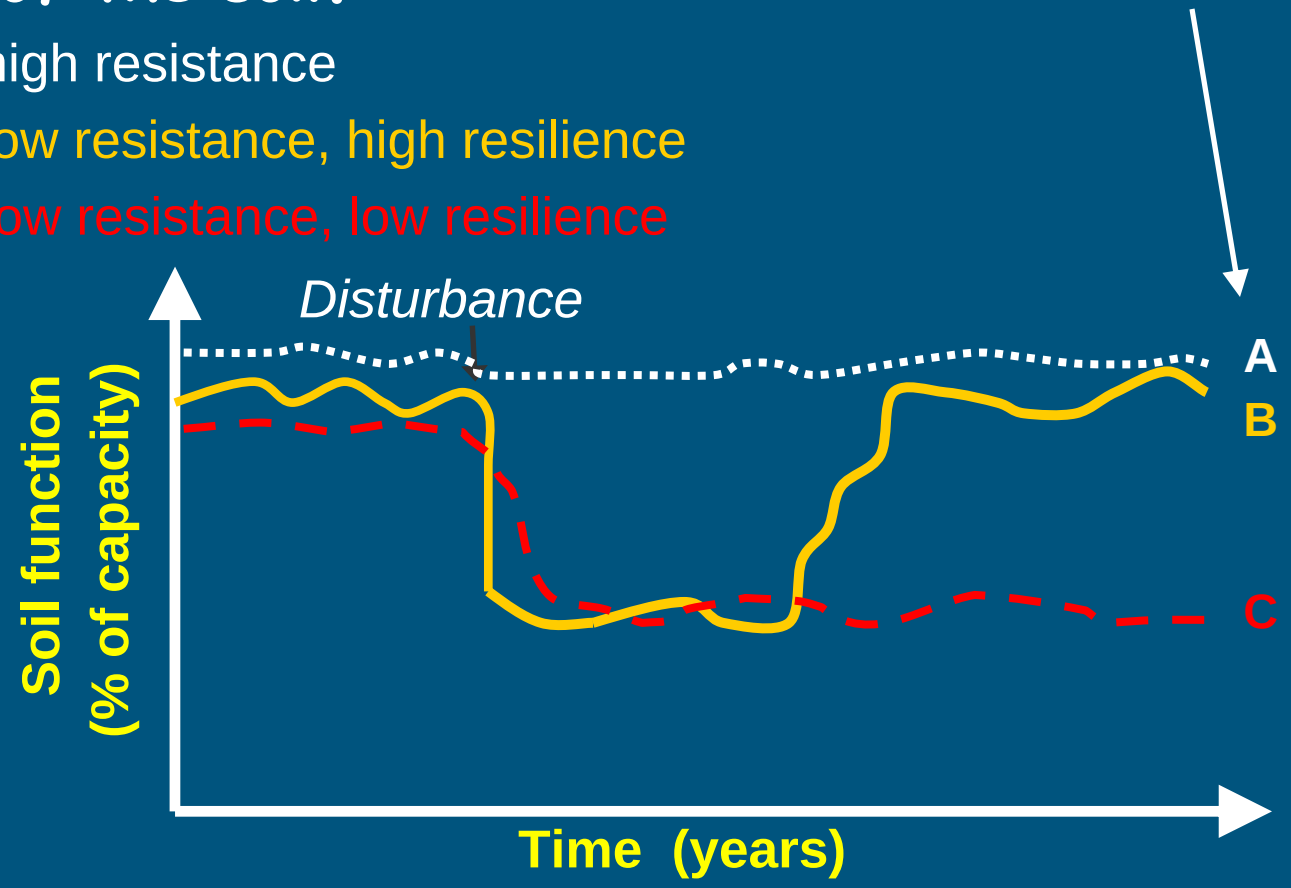
Soil interpretations: Resistance and resilience

Future management options depend on the recoverability (resilience) of the soil.

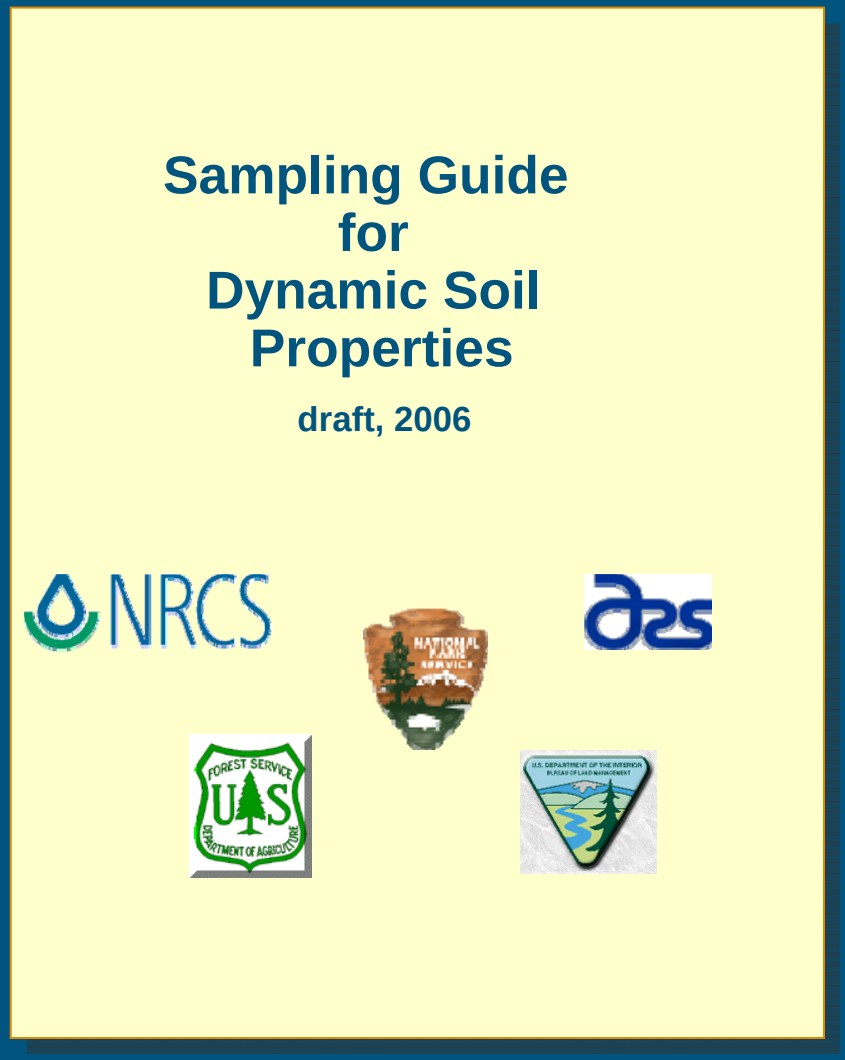
Soil A = high resistance

Soil B = low resistance, high resilience

Soil C = low resistance, low resilience



Soil survey procedures for data collection



Uses comparison studies, NOT monitoring

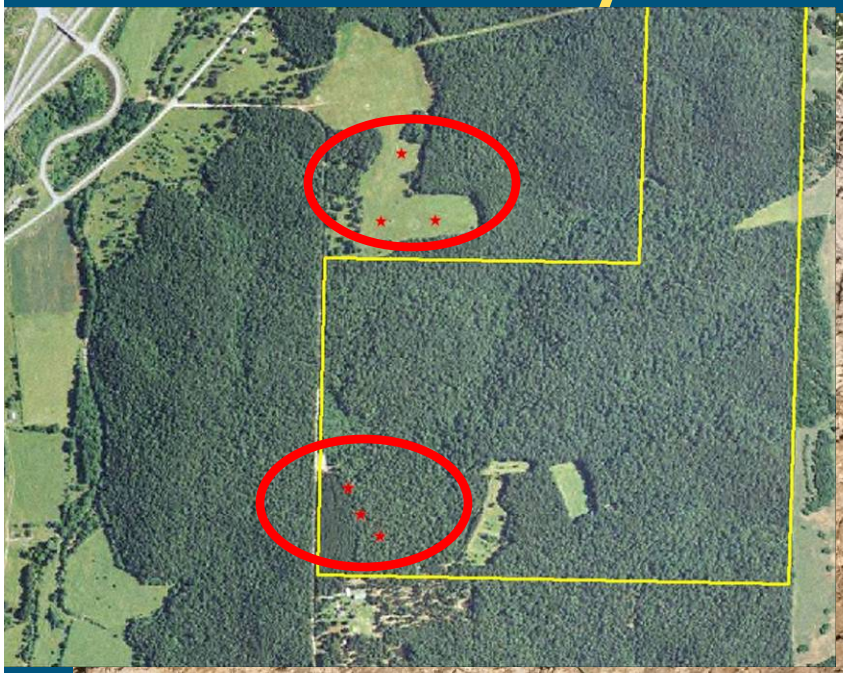
Quantifies reference condition

Instructions for

- Properties to sample (soil, vegetation)
- Management information
- Sample designs
- Data summaries and reports

Pilot Study: Viraton Soil

Springfield Plains, MO



A horizon

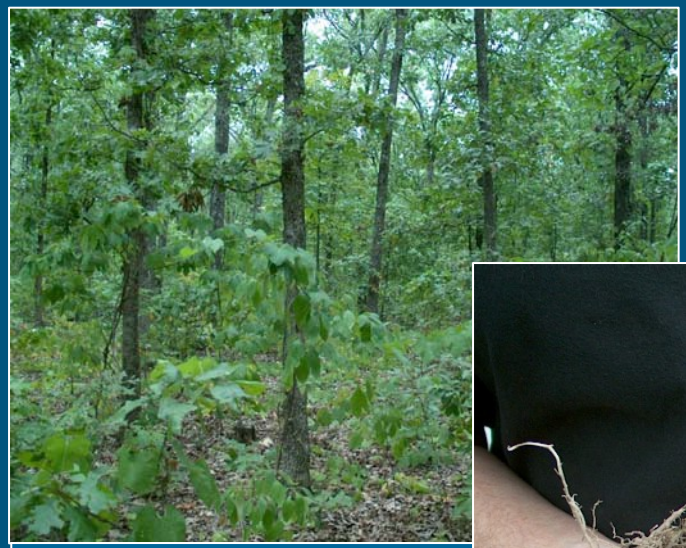
Horizon boundaries

Argillic (Bt) horizons

Top of Fragipan

Fred Young, Allan Johnston, Doug Wallace, John Preston, NRCS

Post oak/blackjack oak/little bluestem



Post oak/flowering d
tick trefoil-goldenrod.
story. Canopy: 30-9

Hot summer burn and
/or long-term grazing

/buckbrush (or
acks mid-story.
ry single species
ominated
open 30-90%

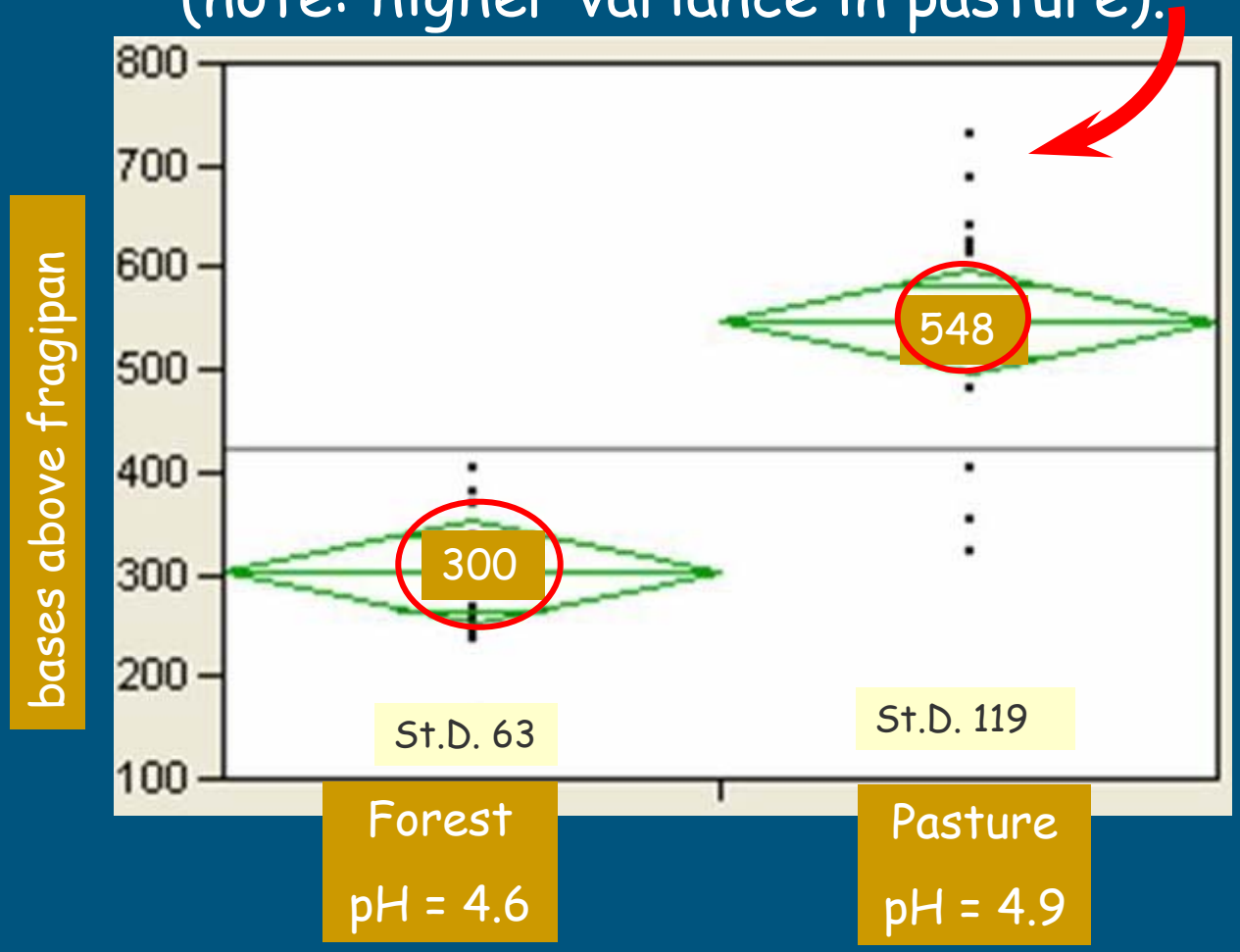
Pasture (improved)
Non-native grass sod

Abandonment
for 20+ yr with
recruitment of
woody natives

Westoby, et. al., 1989
Stringham et.al., 2001

Do total bases differ between land uses?

YES! Higher total bases in pasture (note: higher variance in pasture).



Note: Extractable Ca + Mg + K + Na, summed to the fragipan.

Uses

Soil change data and interpretations will help land managers maintain high quality soils, a productive landscape, and a healthy environment.

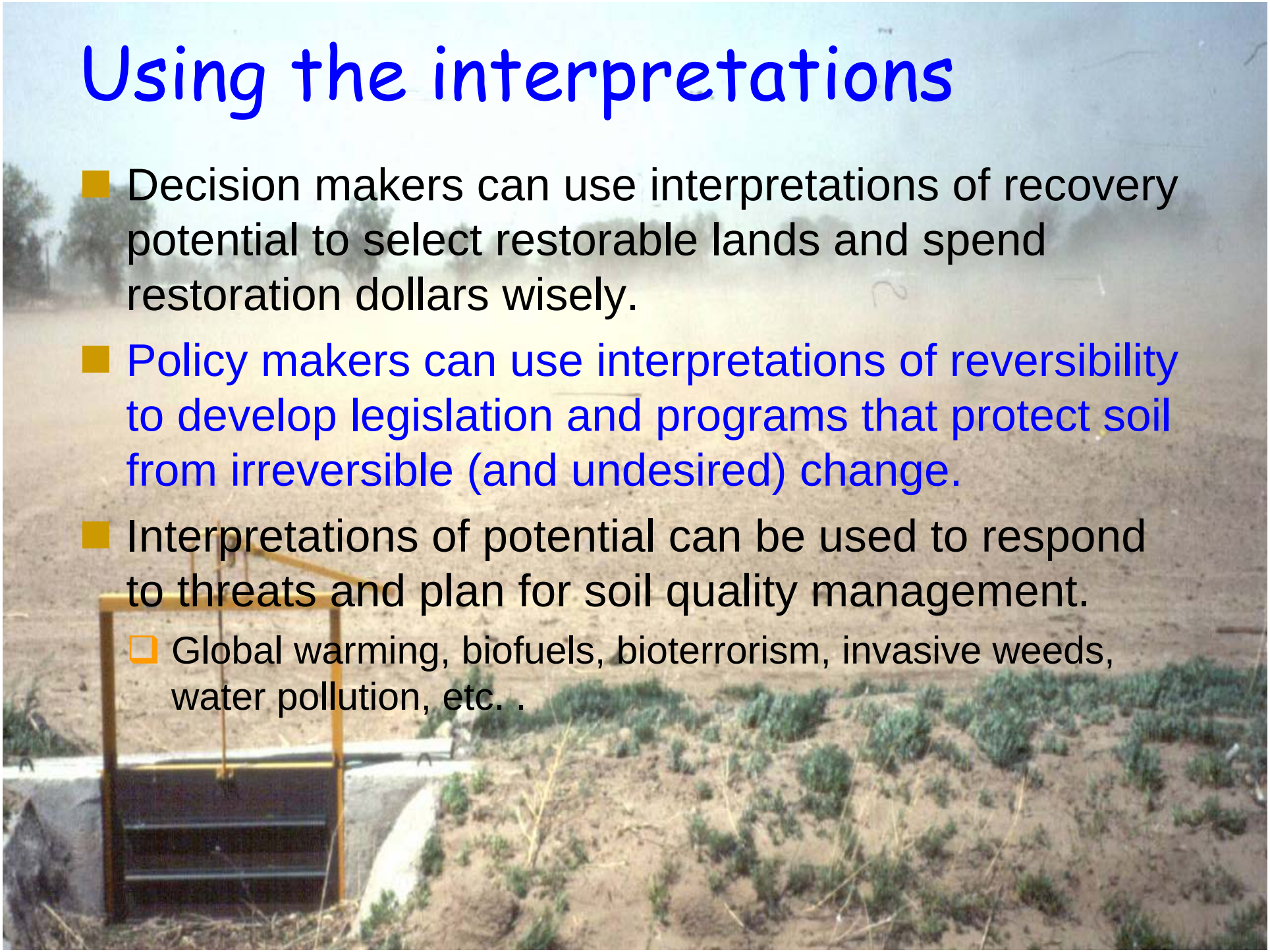
Using the data

- Planners could compare field assessments to reference values for desired condition and recommend practices to improve soil quality.
- Practice designs can be based on more specific conditions for the management system.

  (K factor, hydrologic soil group)
- Restoration effectiveness can be monitored using recommendations of indicators that are likely to change.
- Modelers can build and improve models using point data for specific soils and specific management systems.

Using the interpretations

- Decision makers can use interpretations of recovery potential to select restorable lands and spend restoration dollars wisely.
- Policy makers can use interpretations of reversibility to develop legislation and programs that protect soil from irreversible (and undesired) change.
- Interpretations of potential can be used to respond to threats and plan for soil quality management.
  - Global warming, biofuels, bioterrorism, invasive weeds, water pollution, etc. .



Summary

1. Soil change on the human time scale is an emerging concept for soil survey. Program planning is underway.

2. Dynamic soil property data will help meet customer needs for assessing soil quality, soil functions, and ecosystem services.

3. Data will help planners improve practice designs, show the benefits of conservation systems, and identify lands at risk of irreversible change.

More information

Tugel, A.J., J.E. Herrick, J.R. Brown, M.J. Mausbach, W. Puckett, and K. Hipple. 2005. Soil change, soil survey, and natural resources decision making: A blueprint for action.
Soil Sci. Soc. Am. J. 69:738-747.

Also available online at
http://soil.scijournals.org/content/vol69/issue3/#PEDOLOGY

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Questions???

Objectives of this study

- Quantify dynamic soil property values for two contrasting land uses on a single soil survey map unit component.
- Determine what values differ between land uses, and in what ways.