National Park Service Soil Resources Inventory

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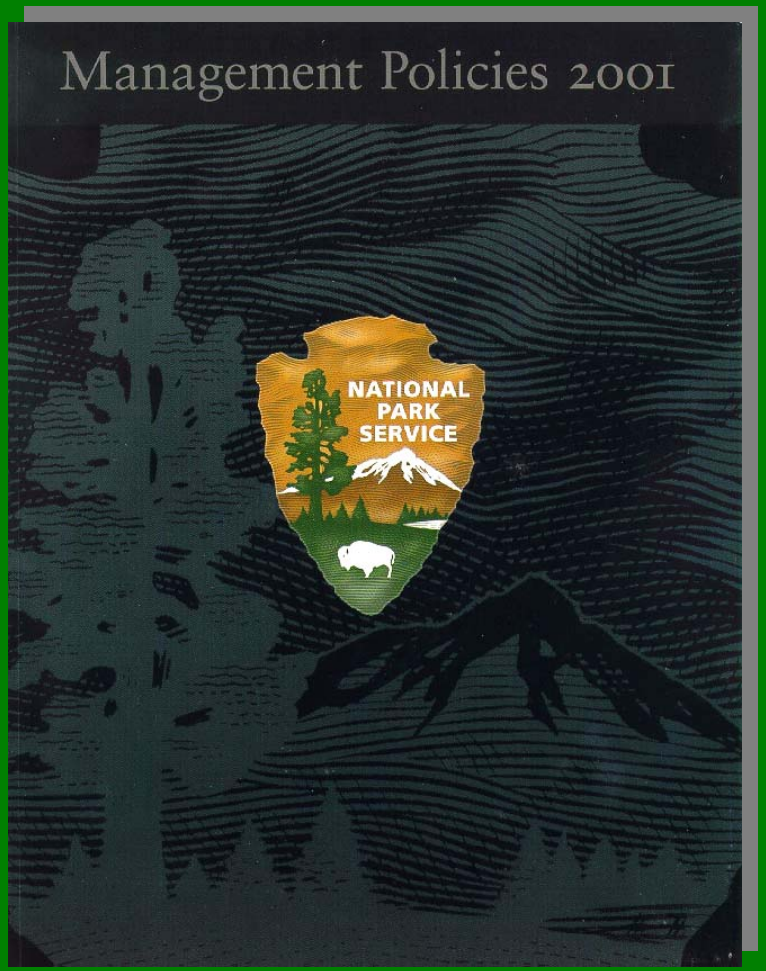
NPS Soil Resources Management



"The Service will actively seek to understand and preserve the soil resources of parks, and to prevent, to the extent possible, the unnatural erosion, physical removal, or contamination of the soil, or its contamination of other resources".

Excerpts from, NPS Management Policies 2001, Part 4.8.2.4 - Soil Resource Management

Soil Resources Management

"Only by having reliable scientific information can park managers take corrective actions before those impacts severely degrade ecosystem integrity or become irreversible"

NPS Soil Resources Inventory

The NPS Inventory and Monitoring Program is obtaining soil surveys on Park Units through agreements with other federal agencies such as the Natural Resources Conservation Service (NRCS) and with private contractors

NPS Soil Resources Inventory

"All soil surveys will follow National Cooperative Soil Survey (NCSS) Standards"

"Mapping will generally be at 1:24,000, except where more detailed surveys are required for park management"

National Cooperative Soil Survey

The NCSS is a nationwide partnership of Federal, Regional, State, and local agencies and institutions working together to cooperatively investigate, inventory, classify, and interpret soils and to disseminate and promote the use of soils information in the United States.

This results in consistency of data collection, as well as database management and database format.

USDA NRCS Natural Resources Conservation Service

Bureau of Reclamation

Soil Resources Inventory Products

Local Park Soils Scoping Session with Network Involvement

Soils map in "hard copy" and digital formats including polygon, linear, and point inferences

Soil map unit delineations

Soil transects and traverses, Riparian map units

Soil pedons, Soil laboratory sample sites, Soil-Vegetation correlation sites, etc.

Soil Resources Inventory Products

Physical, Chemical, and Biological Soil Properties

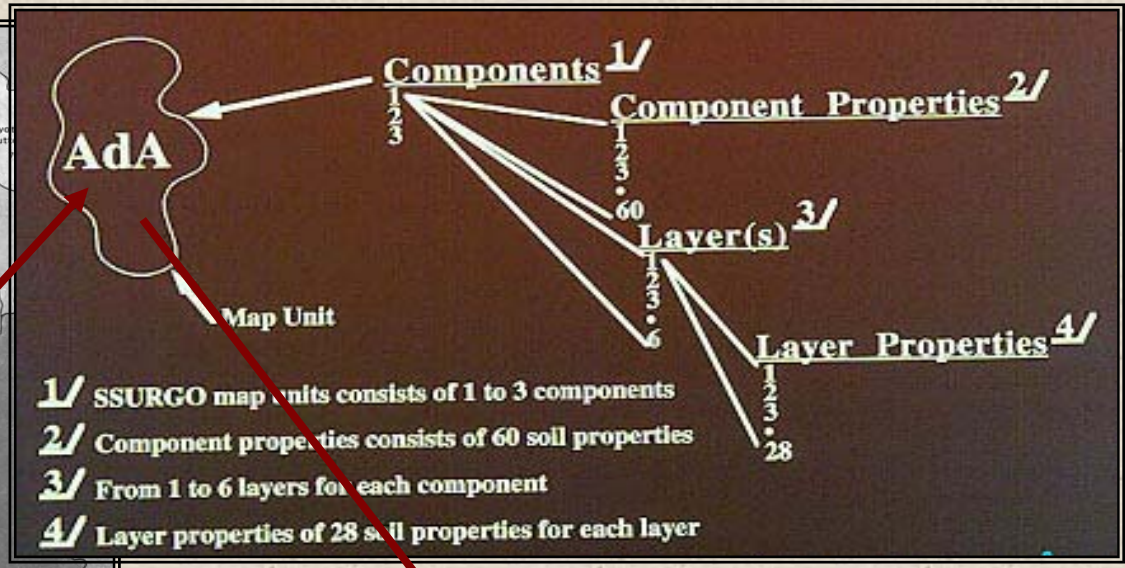
Soil-Plant relationships referenced in Ecological Site Descriptions

Soil Survey Manuscript with Use and Management statements as well as “customized soil interpretations”

Soil profile and landscape images

FGDC compliant Metadata

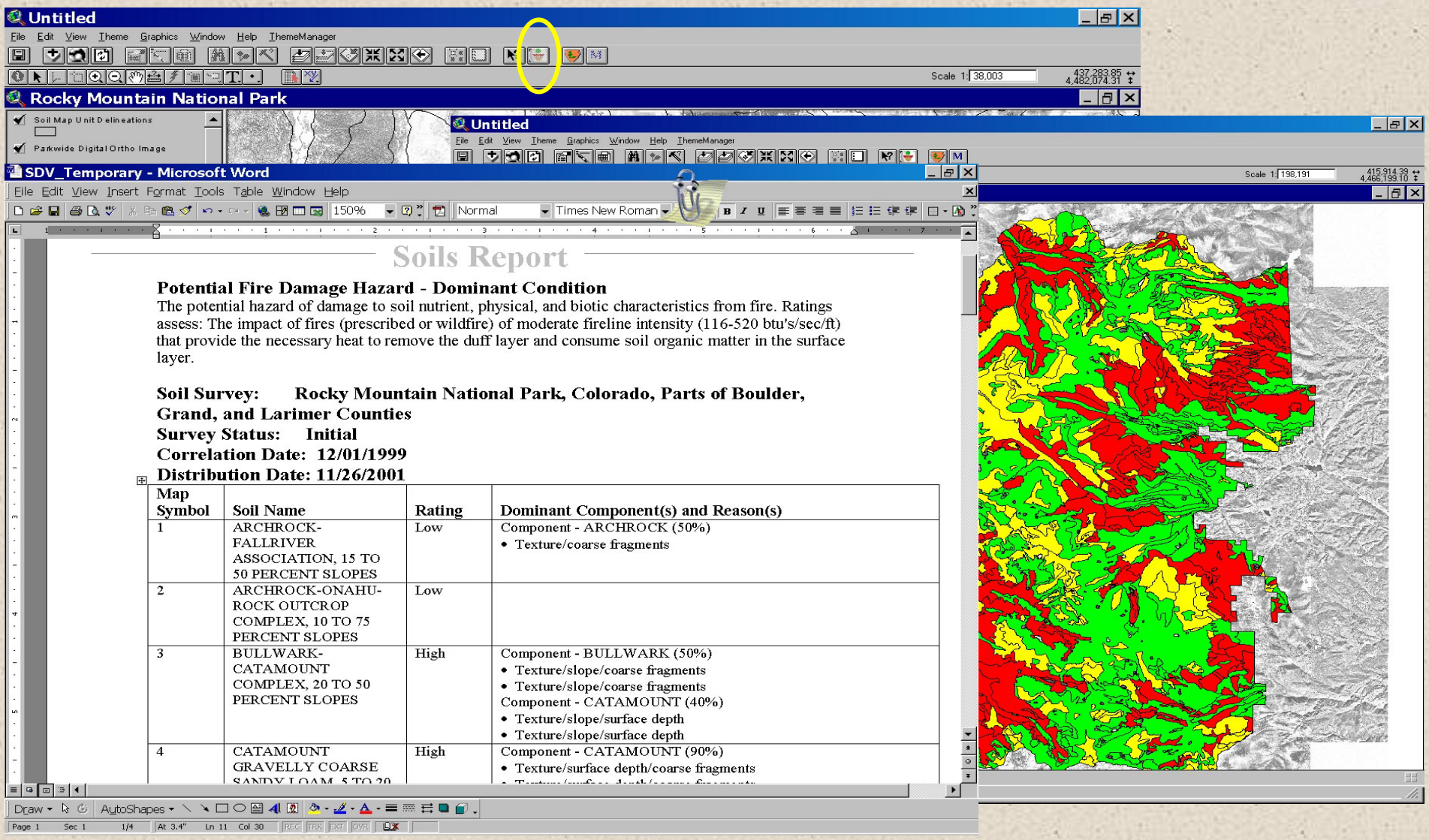
Soil Map Unit Database Concepts



A	B	C	D	E	F
AREA	PERIMETER	CO651_27_	CO651_27_I	MUSYM	MUKEY
2257938.29232	8322.45531	2.00000	1.00000	33	506447
2521801.32352	14994.80703	3.00000	2.00000	25	506438
219.03567	85.03323	4.00000	3.00000	42	506425
2135130.93202	9661.65014	5.00000	4.00000	43	506422
1128477.26921	9084.35479	6.00000	5.00000	42	506425

Soil Data Viewer

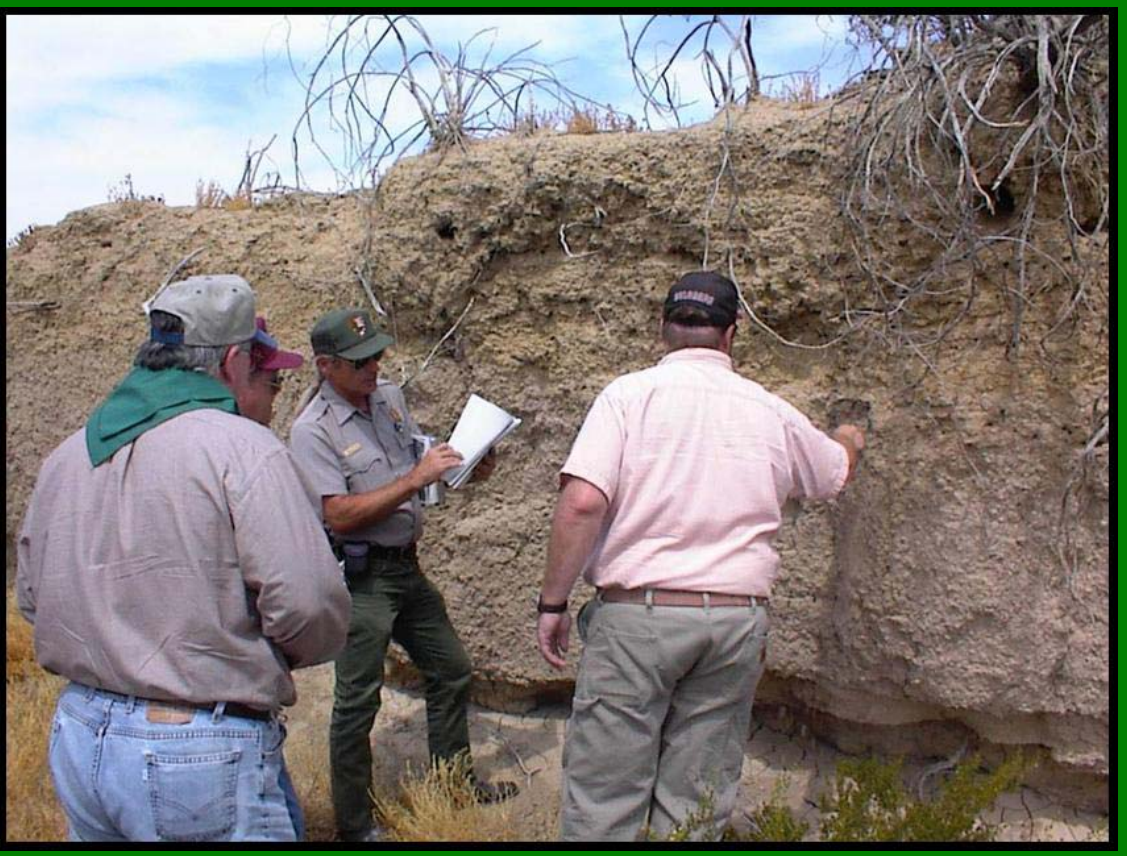
Overview



Soil Information and Education

"We have a challenge to not only collect sound, scientific information on our soil resources for proper management, but we also have a certain responsibility to educate our Park visitors on the role soils play within these ecosystems"

Soil Information and Education Products



Soils “Fact Sheets” for concise information at an overview level that can be further used within General Management Plans (GMP)

“Soil Forming Factors” maps/graphics to provide users concepts on why soils differ within a Park

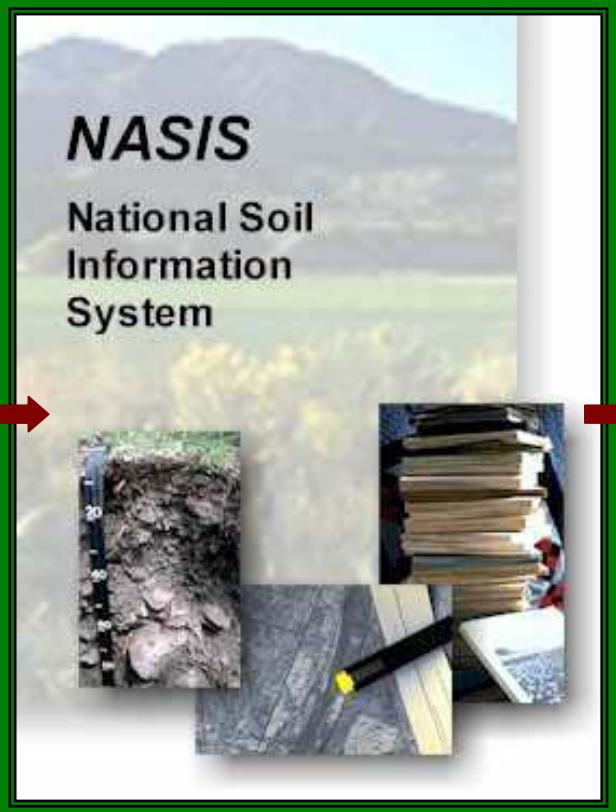
Soil Monoliths

Soil/Landscape Genetic Key

Soils Information in a NPS GIS Theme Manager Format able to be accessed in Soil Data Viewer

Overview of NPS Soil Resources Inventory

PLANTS Database



Soil Fact Sheets

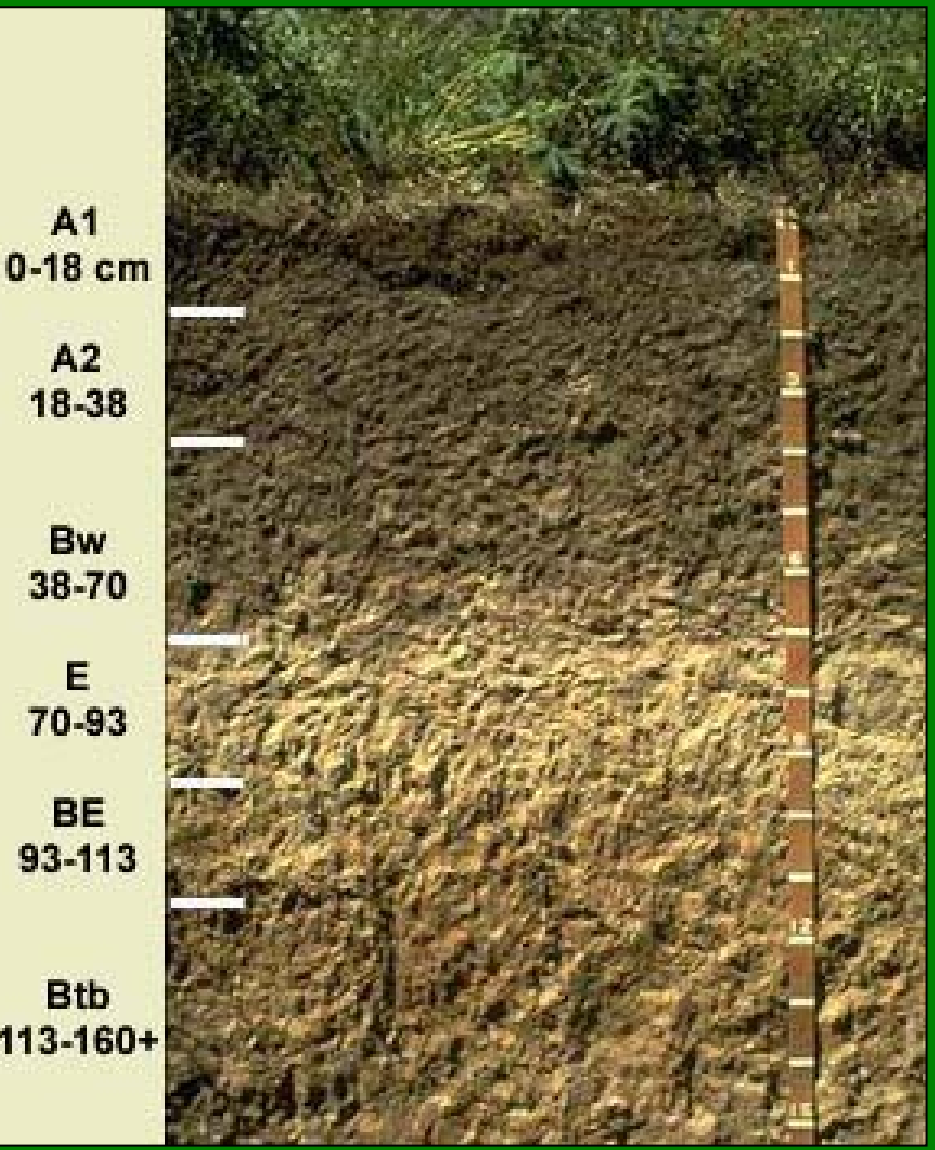
NPS Interpretations

GIS

Soil Data Viewer

Soil Report

Soil Quality



"Soil Quality is the capacity of a specific kind of soil to function, within natural or managed ecosystems, to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation"

Temporal Scales of Soil Change

Millennia

Entisol

Petroargid

Centuries

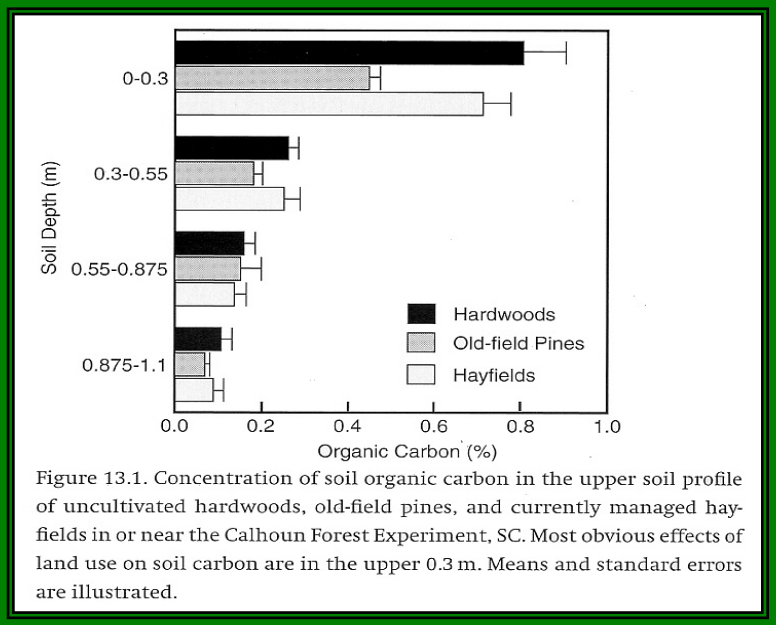
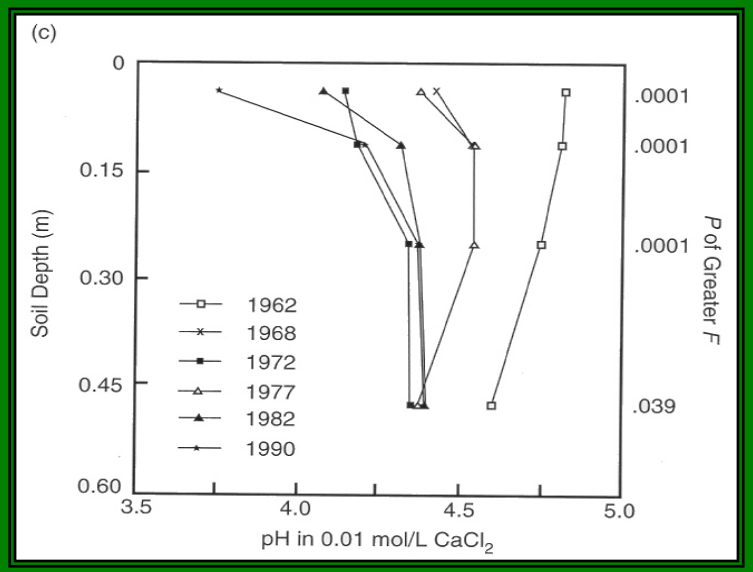
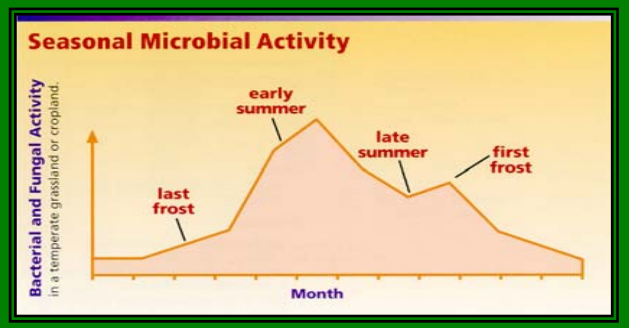


Figure 13.1. Concentration of soil organic carbon in the upper soil profile of uncultivated hardwoods, old-field pines, and currently managed hayfields in or near the Calhoun Forest Experiment, SC. Most obvious effects of land use on soil carbon are in the upper 0.3 m. Means and standard errors are illustrated.

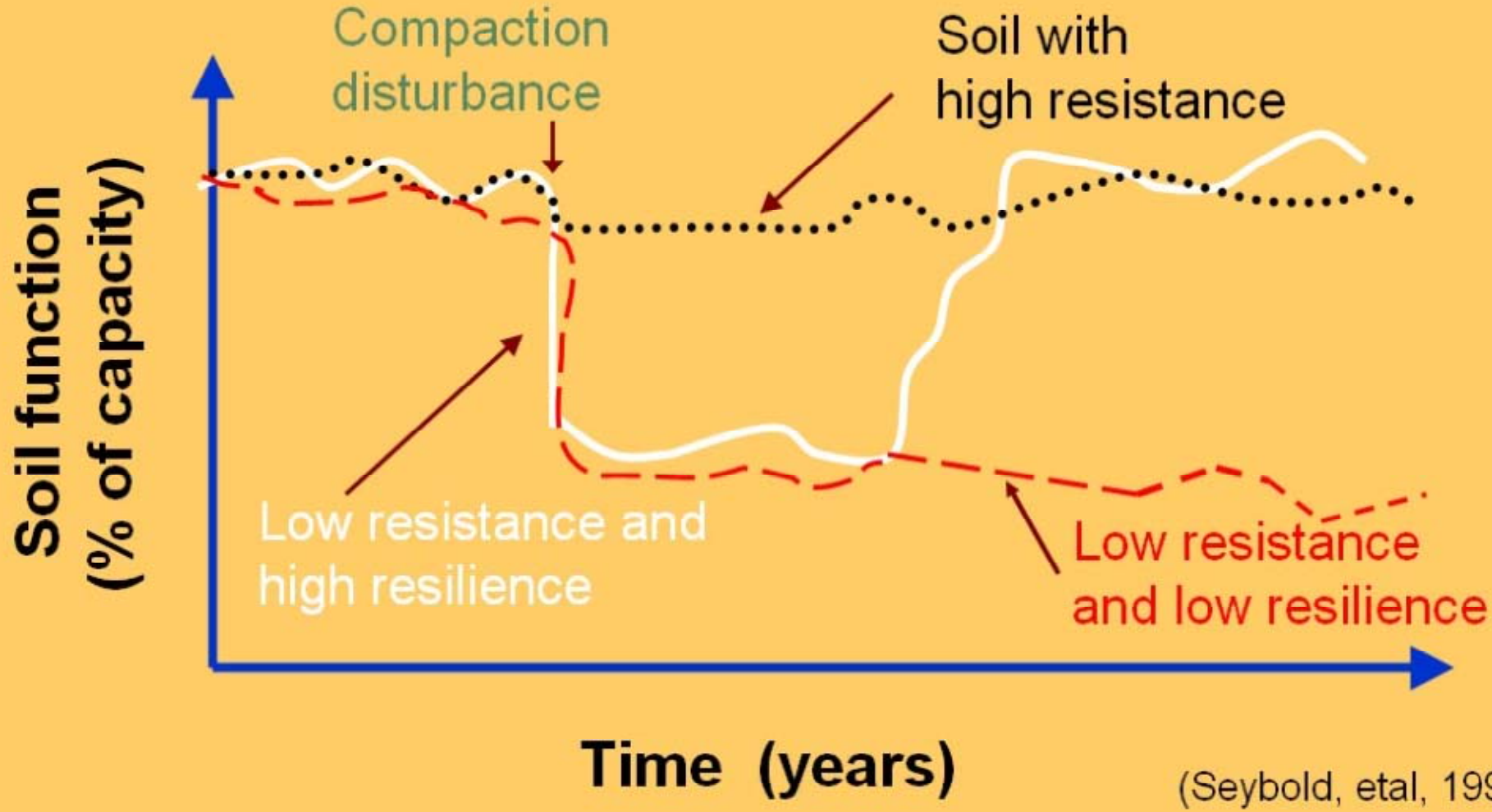
Decades



Yearly, Seasonally, Daily



Soil Resistance and Resilience



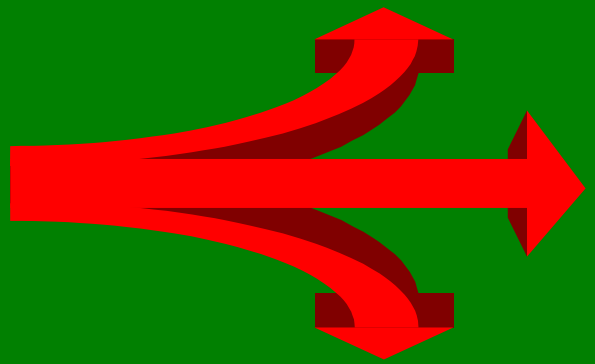
(Seybold, etal, 1999)

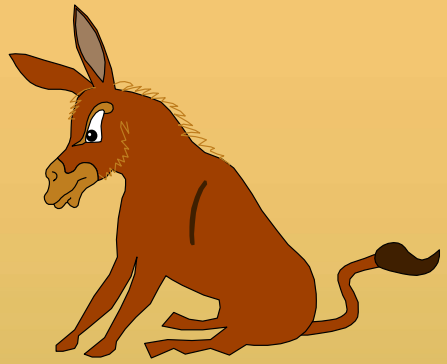
Inherent and Dynamic Soil Properties

The capacity of soils to function depends on:

- Inherent soil features

- Dynamic soil properties (susceptible to change in response to management/climate)





Inherent (static -result of soil formation)

- soil texture
- mineralogy
- horizon sequence
- soil depth
- geomorphic position

Dynamic Soil Properties

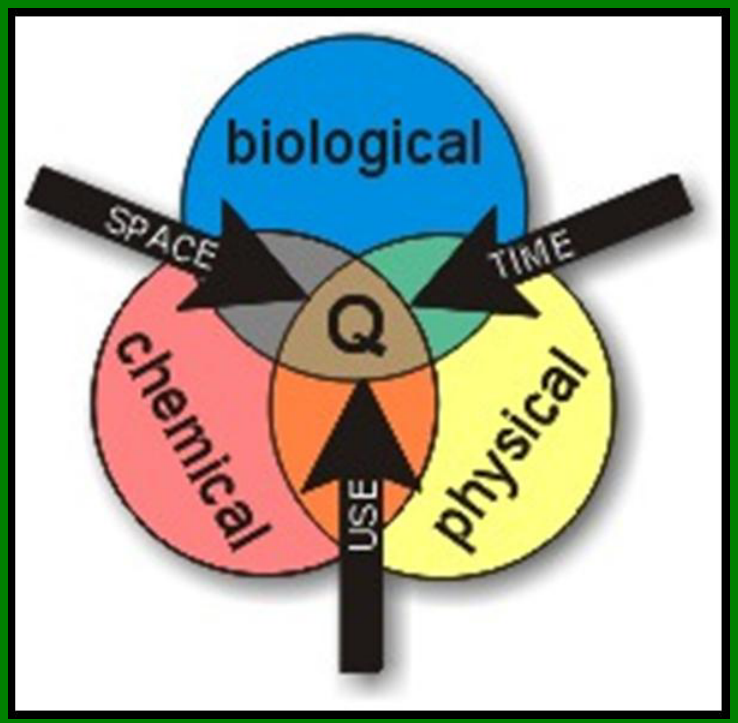
Are susceptible to change in response to changes in climate and/or management

Examples

- infiltration rate
- biological crusts
- topsoil depth
- organic matter
- aggregate stability
- nutrient levels
- salinity
- microbial activity
- distribution pattern
- rills/gullies

Monitoring Soil Resources

It's Not Rocket Science !



Soil Quality and Vital Signs Monitoring

We need to know more about potential impairment to our valuable soil resources, and the ability of our soils to "properly function"

Partnering with the USDA, NRCS, Soil Quality Institute to develop Soil Quality monitoring protocols for use by Vital Signs Networks

Soil Quality Information Sheet

Rangeland Soil Quality—Introduction

USDA, Natural Resources Conservation Service — May 2001

What is rangeland?

Rangeland is land on which the native vegetation is predominantly grasses, grasslike plants, forbs, or shrubs. This land includes natural grasslands, savannas, shrub lands, most deserts, tundras, areas of alpine communities, coastal marshes, and wet meadows.

What is rangeland health?

Rangeland health is the degree to which the integrity of the soil, the vegetation, the water, and the air as well as the ecological processes of the rangeland ecosystem are balanced and sustained.

What is soil?

Soil is a dynamic resource that supports plants. It consists of mineral particles of different sizes (sand, silt, and clay), organic matter, and numerous species of living organisms. Soil has biological, chemical, and physical properties, some of which change in response to how the soil is managed.

What is soil quality?

Soil quality is the capacity of a specific kind of soil to function within natural or managed ecosystem boundaries, sustain plant and animal productivity, maintain or enhance the quality of water and air, and support human health and habitation. Changes in the capacity of soil to function are reflected in soil properties that change in response to management or climate.

What does soil quality affect on rangeland?

- Plant production, reproduction, and mortality
- Erosion
- Water yields and water quality
- Wildlife habitat
- Carbon sequestration
- Vegetation changes
- Establishment and growth of invasive plants
- Rangeland health

How are soil quality and rangeland health related?

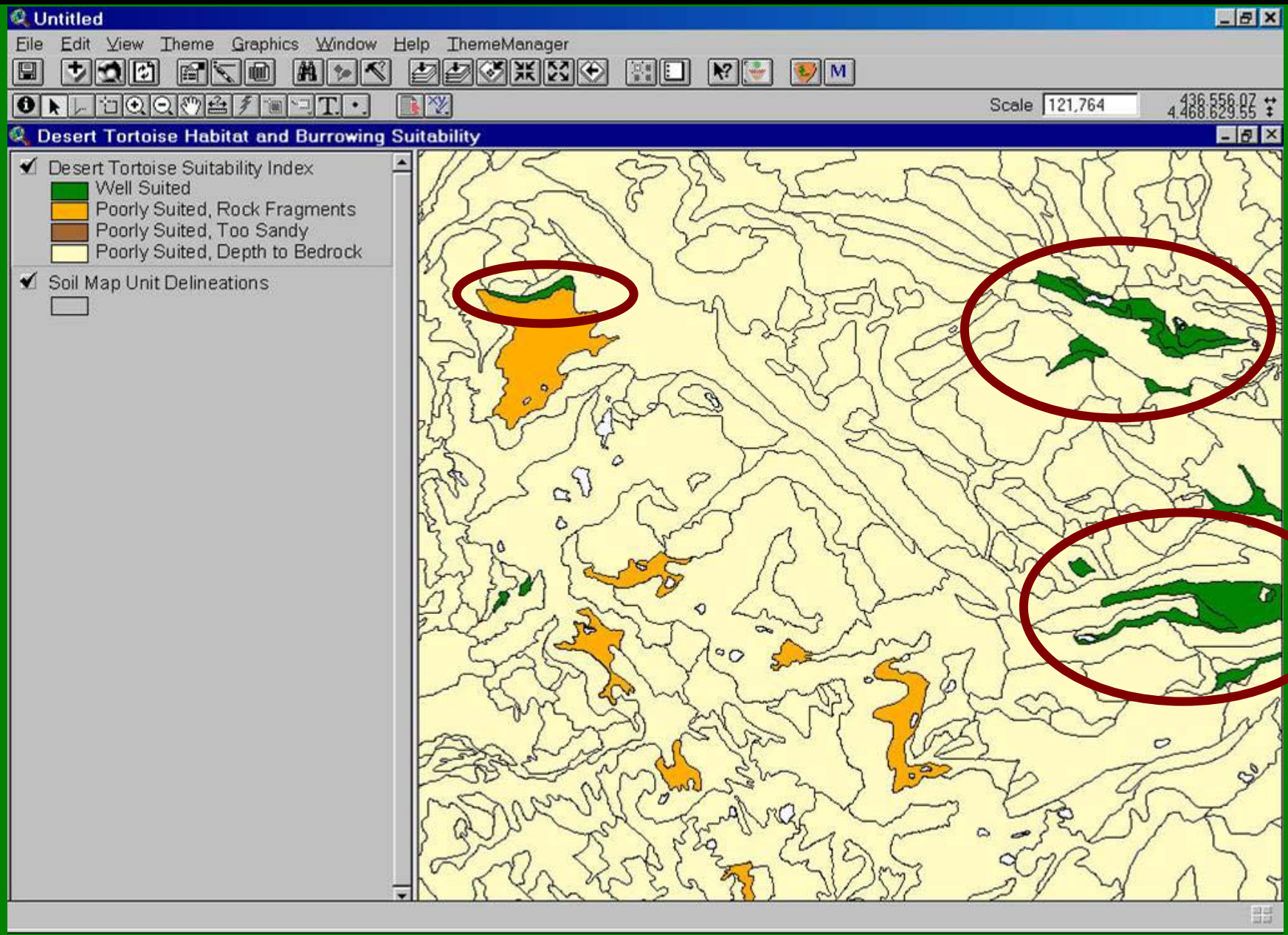
Rangeland health and soil quality are interdependent. Rangeland health is characterized by the functioning of both the soil and the plant communities. The capacity of the soil to function affects ecological processes, including the capture, storage, and redistribution of water; the growth of plants; and the cycling of plant nutrients. For example, increased physical crusting decreases the infiltration capacity of the soil and thus the amount of water available to plants. As the availability of water decreases, plant production declines, some plant species may disappear, and the less desirable species may increase in abundance. Changes in vegetation may precede or follow changes in soil properties and processes. Significant shifts in vegetation generally are associated with changes in soil properties and processes and/or the redistribution of soil resources across the landscape. In some cases, such as accelerated erosion resulting in a change in the soil profile, this shift may be irreversible, while in others, recovery is possible.

Why is soil quality important?

Changes in soil quality that occur as a result of management affect:

- the amount of water from rainfall and snowmelt that is available for plant growth;
- runoff, water infiltration, and the potential for erosion;
- the availability of nutrients for plant growth;

Soils and Threatened and Endangered Species Monitoring



Example Network Implementation of Soil Quality

Vital Signs Framework

NCPN Vital-Sign Categories, 5/11/03

THEME	VITAL-SIGN CATEGORY	EXPLANATION
1. Ecosystem structure & function	1.01. Climate	Abiotic & biotic indicators of climatic / meteorological conditions that drive ecological processes.
	1.02. Air quality	Abiotic & biotic indicators of air quality conditions.
	Soil Quality	Abiotic & biotic indicators of upland (hillslope) hydrologic function, soil quality, soil-site stability, nutrient cycling.
	1.04. Upland disturbance regimes	Abiotic & biotic indicators associated with the occurrence, likelihood, or management of fire-, insect-, and drought-related disturbances.
	1.05. Upland & riparian communities	Integrity of vascular & nonvascular plant communities, key vertebrate communities, and & obligate communities associated with springs / seeps / hanging gardens.
	1.06. Aquatic, riparian & wetland hydrologic / geomorphic regimes	Abiotic & biotic indicators of hydrologic / geomorphic regimes; hydrologic function; water quantity.
	1.07. Water quality	Abiotic & biotic indicators of water quality.
	1.08. Aquatic communities	Integrity of aquatic vertebrate, & macroinvertebrate, and macrophyte communities.
	1.09. Landscape-level patterns	Indicators of system dimensions; connectivity; fragmentation; land-use, land-cover, and land-condition patterns.

Soil Quality and Soil Functions

Desired soil functions from NCPN perspective:

- Regulate hydrologic processes
- Support characteristic (native) plant & animal populations
- Capture / retain / cycle nutrients

NCPN Soil Quality Indicators

.03. UPLAND SOIL & WATER RESOURCES -- Abiotic & biotic indicators of upland (hillslope) hydrologic function, soil quality, soil-
site stability, nutrient cycling.

Distribution / extent of soil disturbances
- Spatial distribution / density of social trails
- Spatial distribution / density of trailing by large ungulates
- Spatial distribution / density of vehicular disturbances
- Spatial extent of soil disturbances associated with trailheads, campgrounds, and other high-use areas
- Number, distribution, and condition / spatial extent of backcountry campsites

Soil erosion resistance & soil biotic activity
- Percent cover of biological soil crusts by morphological group
- Percent live canopy cover of vascular plants by species
- Soil aggregate stability
- Percent bare soil
- Percent cover of litter

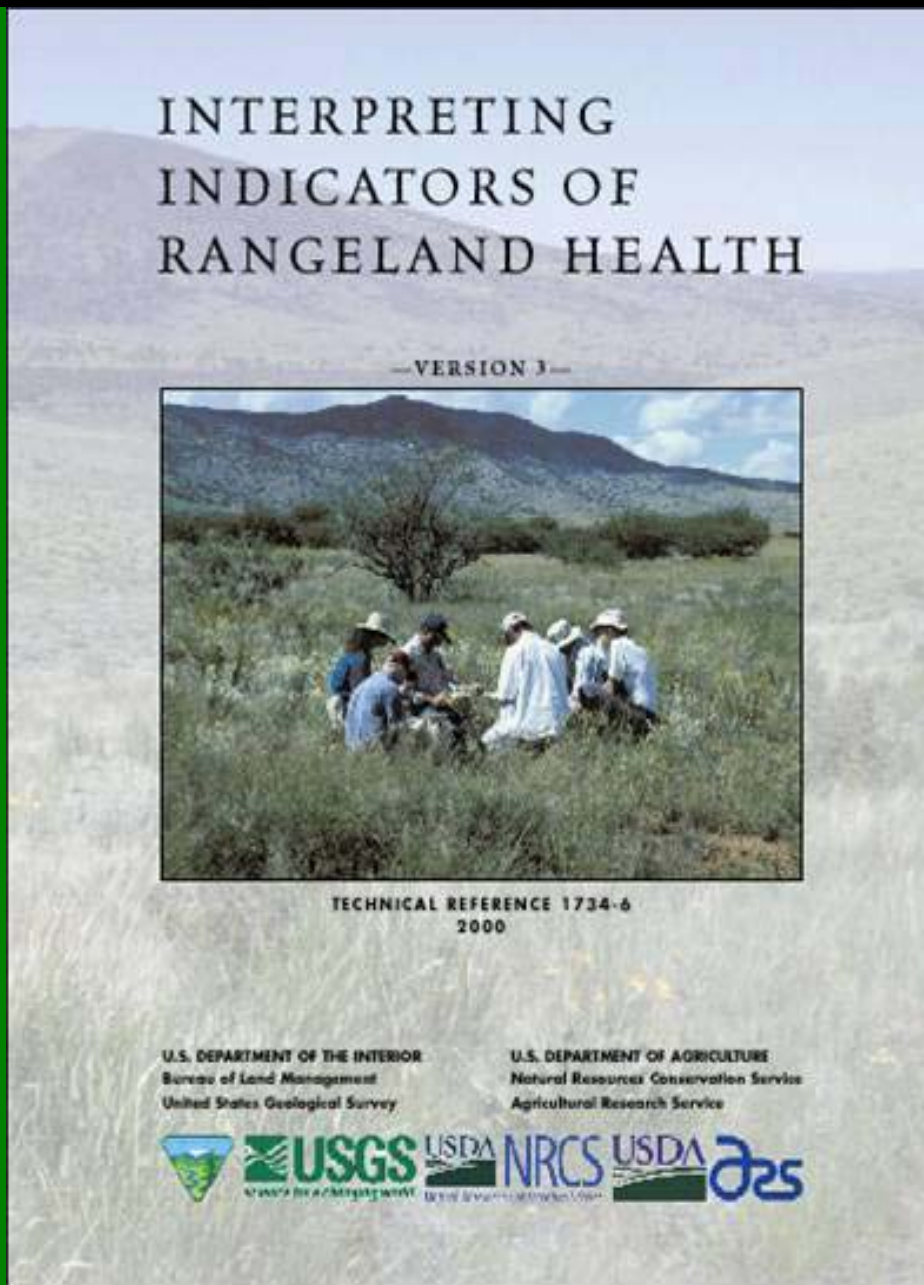
Soil movement by wind & water
- Soil loss from hillslopes (e.g., changes in soil-surface height from benchmark)
- Soil movement / accumulation – fluvial processes (e.g., soil accumulation behind silt fences or natural sediment traps)
- Soil movement / accumulation – aeolian processes (e.g., soil accumulation in dust traps)

Degree of soil compaction
- Soil penetration resistance

Applications of Soil Site Information

Condition Inventories

Qualitative assessments of ecosystem condition for purposes of determining monitoring needs.



Applications of Soil - Site Information

Monitoring Design & Interpretation

Spatial stratification in relation to:

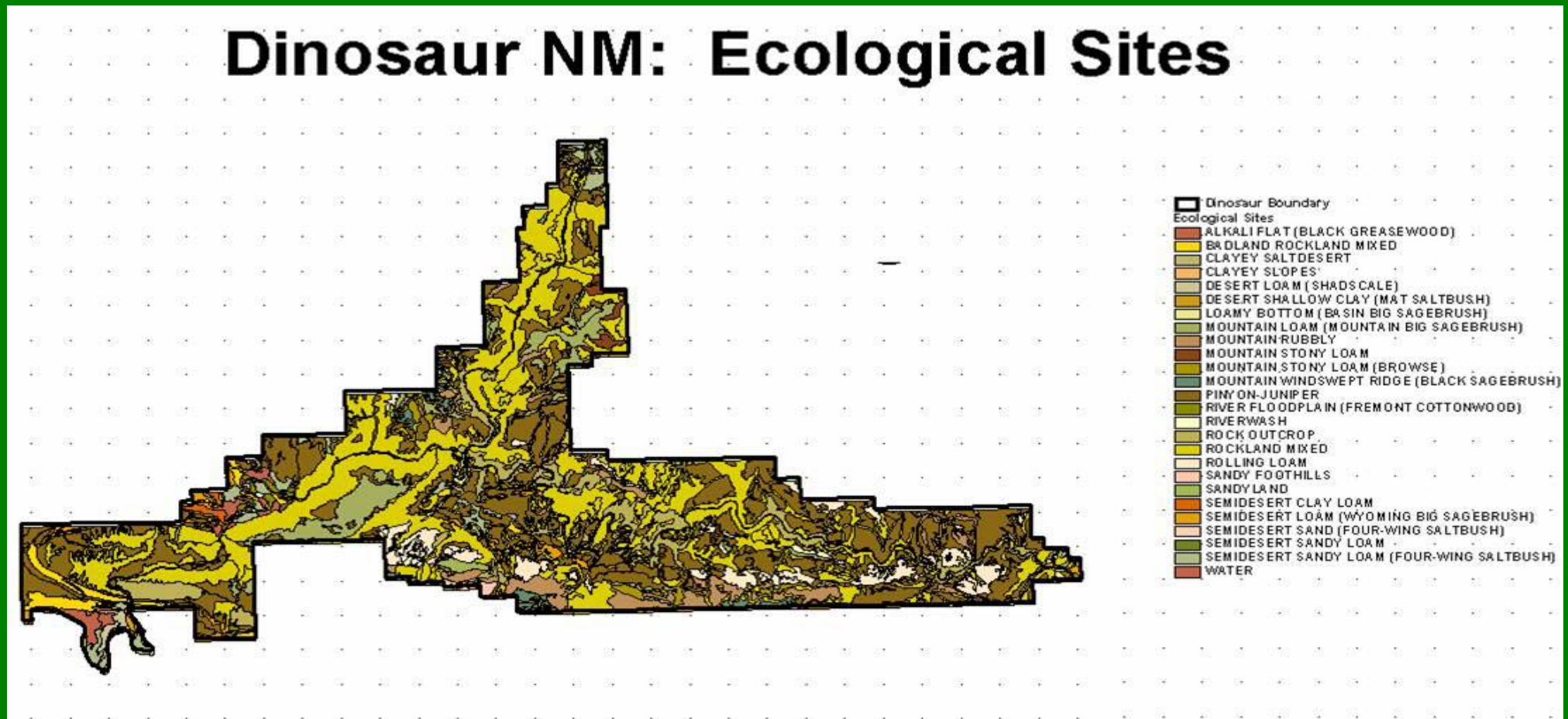
- Current ecosystem condition.

- Inherent & dynamic soil / ecosystem properties that determine the resistance / resilience of soil / ecosystem functions to predominant disturbances.

Applications of Soil-Site Information

Exotic Species Invasions

- Spatial modeling of invasion patterns in relation to soil / site characteristics to support early-detection monitoring



NPS Soil Resources Inventory Status

Complete – 58

In Progress - 31

Future Directions

✓Continued interactions with Parks and Vital Signs Networks to acquire applicable Soil Resource Inventories

✓Partnerships with other federal land management agencies to allow for “cross – boundary” soil resource management and/or monitoring opportunities

✓Pursue use of Predictive Soil Mapping (PSM) techniques for inaccessible or wilderness areas where traditional soil observation methods are not feasible