Dynamic Soil Properties and the Soil Survey

Pilot Project in Arches National Park

2005

Presented by

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Background and Perspective

- Interactions between the NRCS and the National Park Service.
- NPS's interests defined during the scoping meeting:
  - Increased understanding of the interrelationships between soils and plant communities.
  - Information on what affect visitor impact has on soil compaction, soil surface disturbance, and biological crusts.
  - Examine relationship between current soil properties and plant communities, as well as the possible effects of historical grazing.
  - Development of a set of DSP which may be monitored as indicators of transition between states, to assist timely management decisions.

Dynamic Soil Properties

- What are they?
- How practicable is it to gather the necessary data for DSP?
- Can it be done within the scope of a routine soil survey update?
- Are the results useful for the development of the published soil survey?

Introduction

- Overview of the project
- Description of methods/approach
- Evaluation of methods
- Recommendations for future DSP sampling
- Review of the practicability and the usefulness of the DSP data collection
- Results, and Future

Overview

Objectives of Pilot

- Evaluate and test sampling methods

  And

- Evaluate DSP’s to….
  - Examine relationship between the DSP’s of the soil and the plant community characteristics
  - Help identify a set of DSP’s to be monitored by NPS as indicators of transition between states - will facilitate making management decisions in a timely manner

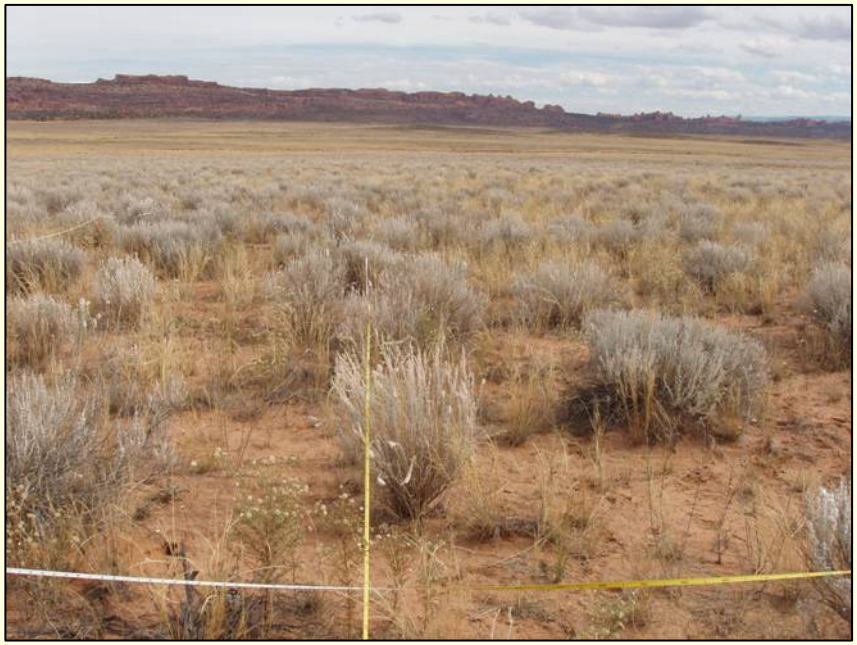
Overview

- Soil: Begay fsl, 1-6% slopes (Coarse-loamy, mixed, superactive, mesic Ustic Haplocambid)
- Ecological Site:

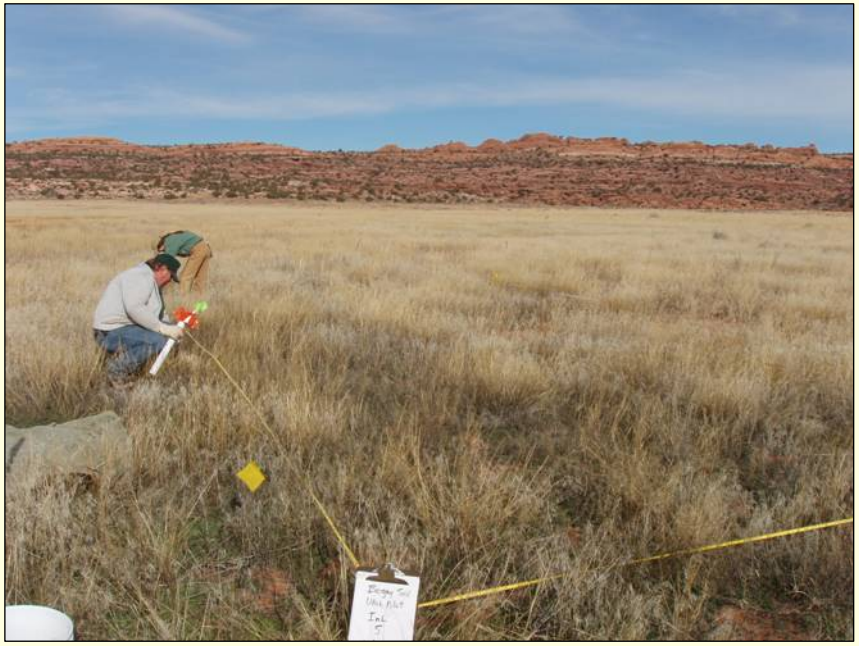
  Semidesert Sandy Loam (Fourwing saltbush) MLRA 35
- Two plant communities

Utah Pilot
Arches National Park

Weed invasion



Mixed perennial grass/shrub community

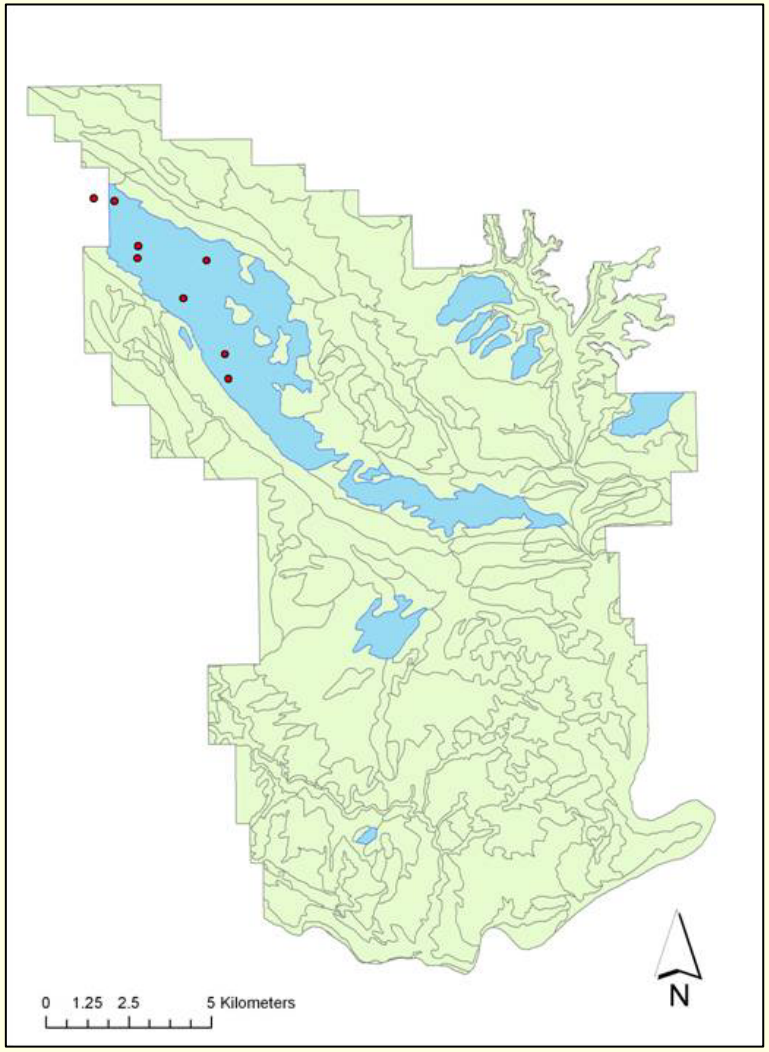


Annual grass invaded (cheatgrass) community

Randomly located plots

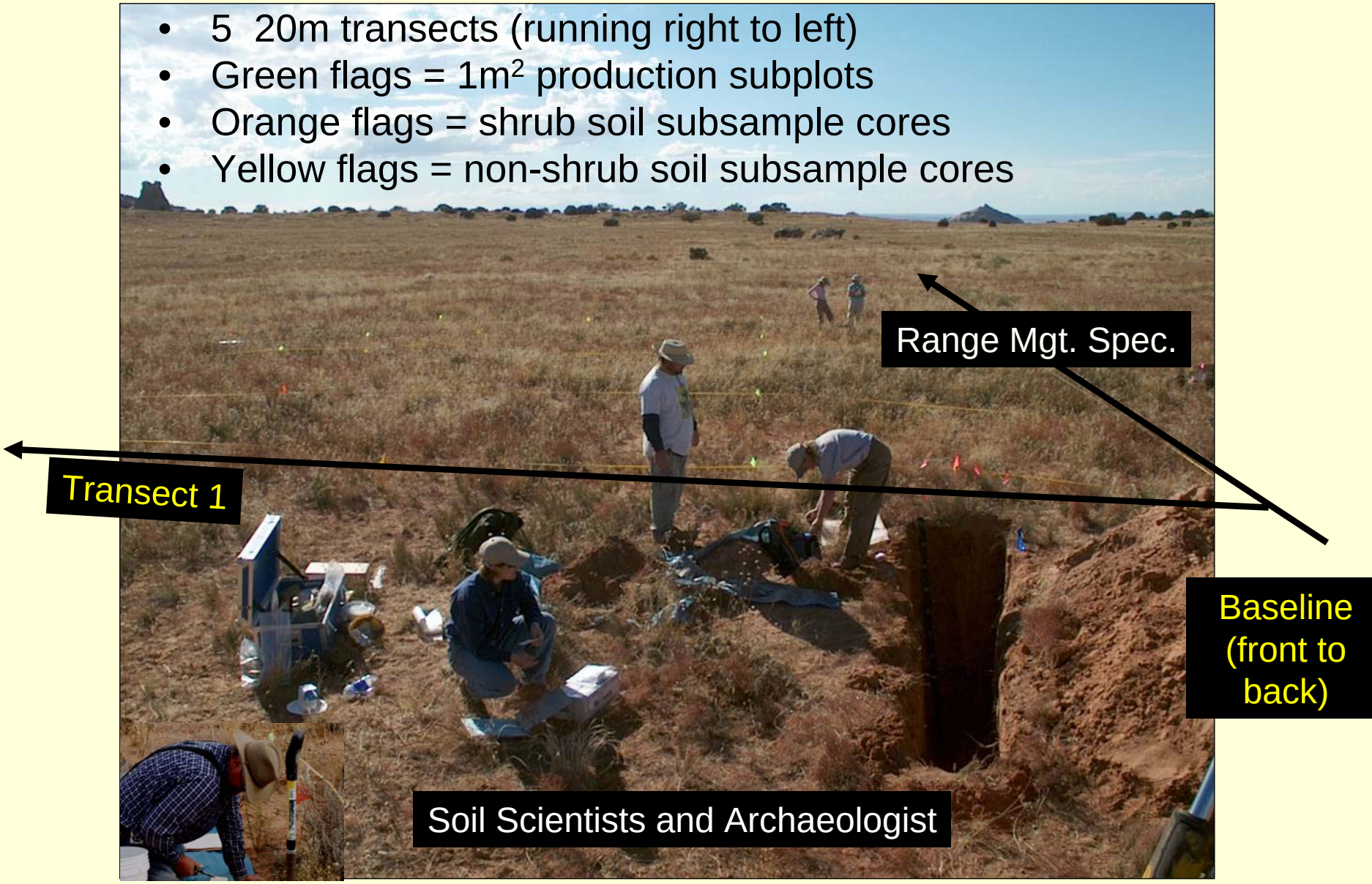
Begay fine sandy loam,
1-6% slopes

- Procedures were GIS based
- 4 plots perennial grass-shrub
- 4 plots invaded cheat grass
- Replicated sampling in 20 meter by 20 meter plots

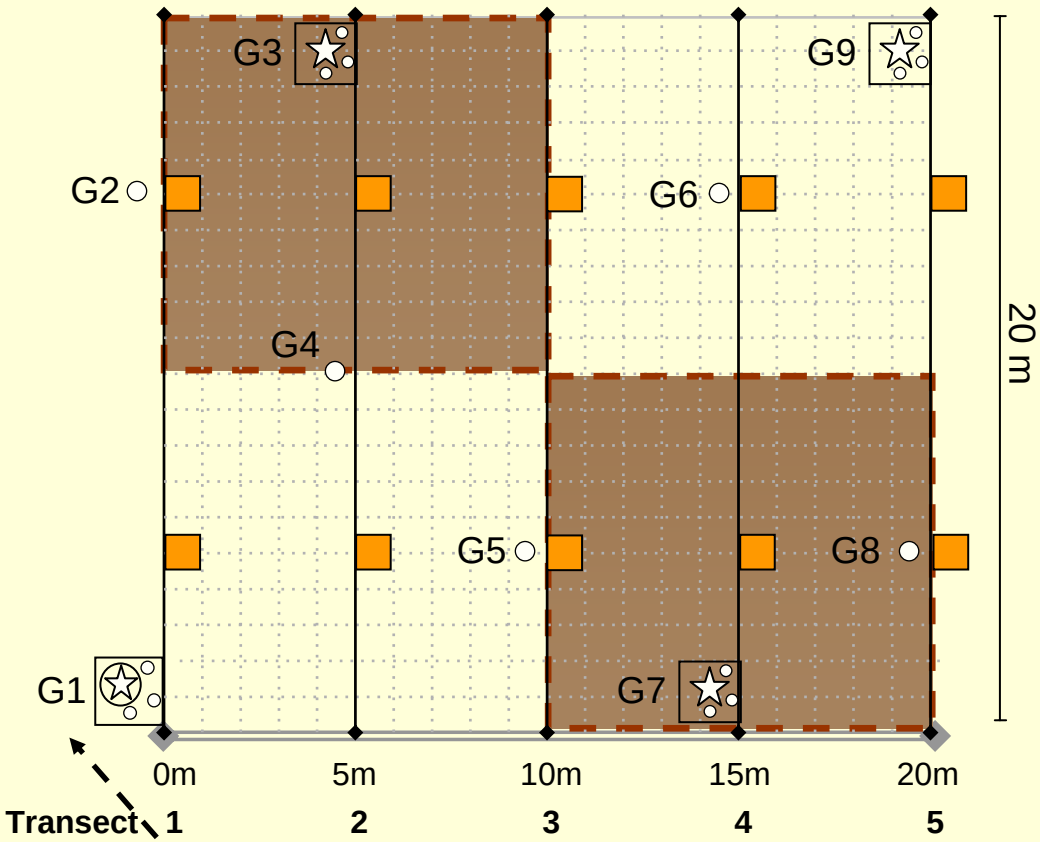


20 m^2 Plot design (2 stratum), Arches NP, UT 2005

- 5 20m transects (running right to left)
- Green flags = 1m^2 production subplots
- Orange flags = shrub soil subsample cores
- Yellow flags = non-shrub soil subsample cores



Plot configuration and co-location of measurements, Utah



Baseline, 20 m long

Transect, 20m long

Herbaceous production subplot, 1m-sq

Woody production subplot, 100m-sq

G# Stratum subsample ID

Soil subsample

Soil subsample, full pedon description

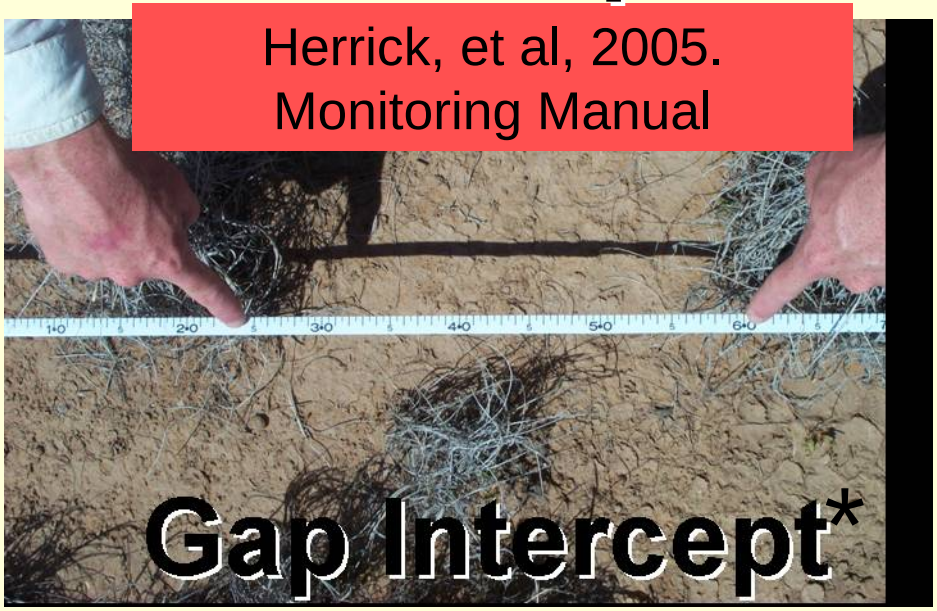
Soil stability subsample

Soil subsample with 3 stabilty samples within 25 cm x 25 cm square

November 05, 2005

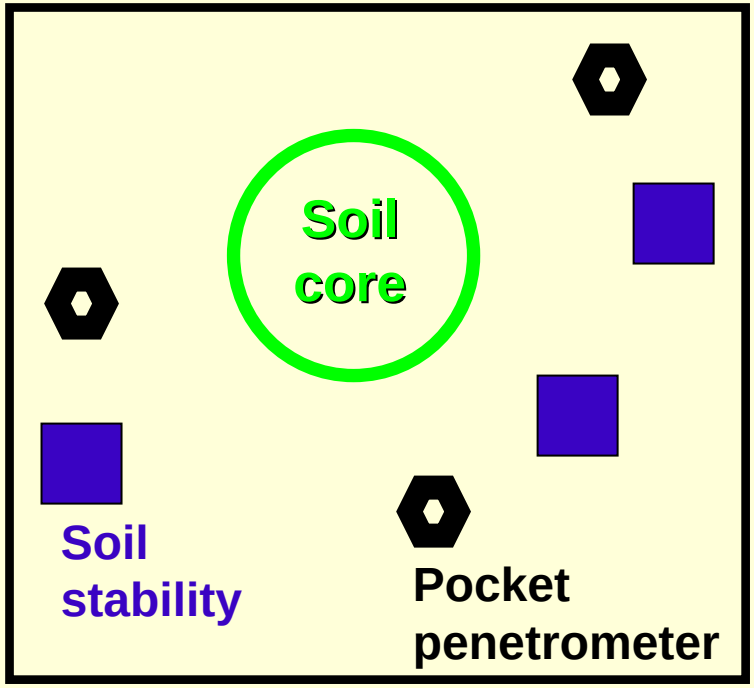
Vegetation measurements (*also in NRI)

Herrick, et al, 2005. Monitoring Manual



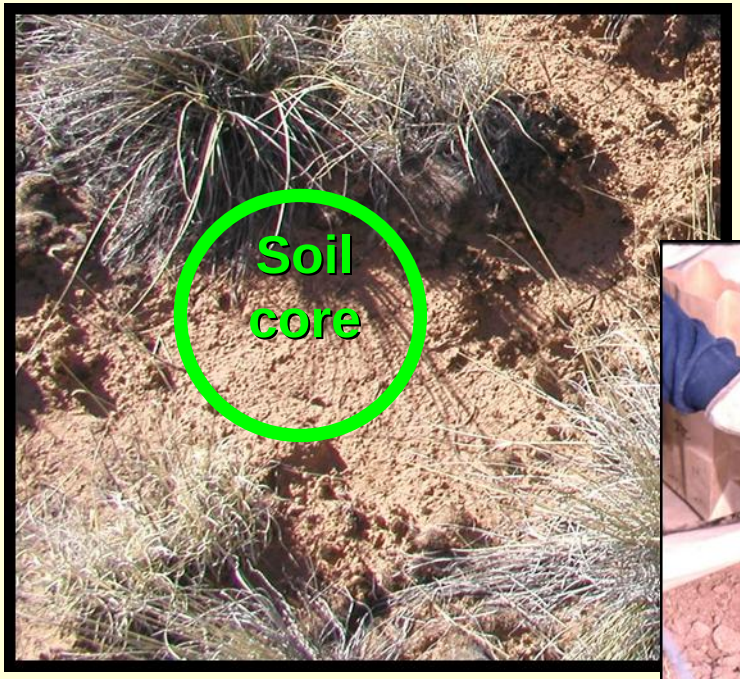
Soil sub-sample plots: Pedoderm features

25 cm



- Soil crust-pedoderm class
- Basal grass cover 4 classes

Soil sub-sample plots: Near surface layers



- Bulk density
- Carbon
- ❖ Active carbon
- CaCO3
- Texture
- EC, pH, etc

Soil Core Depths

- 0-2 cm
- 2 cm to base of A horizon
- Upper 17 cm of B horizon (~25cm)

❖ Penetration resistance to 30cm

2cm
5cm
8cm
….30cm

Methods that Worked (Soils)

- Backhoe pits in each plant community
- Full soil profile description (232’s) at each plot
- Bulk density measurements
- Crust/pedoderm classes
- Soil stability
- Basal grass cover
- Penetration resistance (penetrometers)

Methods that Worked (Vegetation)

- Plot Layout
- Within-plot subsample locations
- Line point intercept
- Gap intercept
- Production estimates
- Similar time requirements for data collection (soils/vegetation)

Procedures that were Cumbersome

- Random sampling points (time-consuming)
- Defining / locating vegetation that solidly represented the defined unique communities
- Length of sampling time (Oct. –Dec.)
- Surface roughness method

Recommendations

- Define and locate the unique vegetation communities to better fit with the project goals and the proposed state and transition models
- Improve point selection process
- Coincide timing of the DSP sampling with ideal vegetation and soil conditions

#1 Take home message

Location, location, location…

Selecting sample sites on the same soil and the proper plant community/management system is the most important step!

Need a soil scientist and a vegetation specialist working together to do this.

Utah field workload, 2005

- Planning and preparation time: 3 weeks over 5 month period
- Plot selection: 2 weeks
- ~1 week training + two backhoe pits
- 2 weeks sampling (140 samples)
- 6-7 hours per plot for 3.5 people

Recap

- How practicable was it to gather the necessary data for DSP?
- Can it be done within the scope of a normal soil survey update?
- Were the results useful for the development of the published soil survey?

Results: Steps for DSP projects

Preparation

1. Define objectives
2. Establish project details (work plan)
3. Develop state and transition model, gather management history
4. Develop statistically based sampling design

Field work

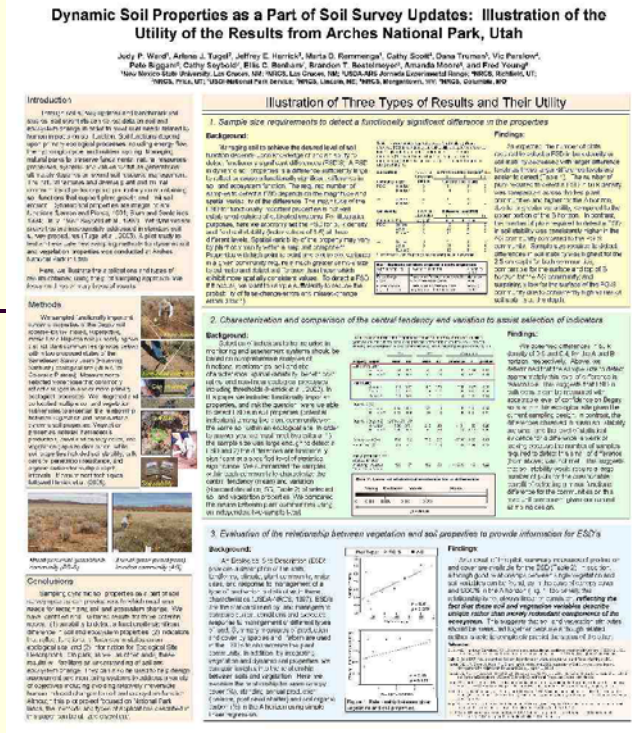
5. Verify soil/plant community of potential sample locations; select plots
6. Collect data and samples (after training)

Data processing and Interpretation

7. Enter raw field data (interim storage in spreadsheet or database)
8. Acquire sample data from laboratory
9. Compile and error check raw data; generate and summarize descriptive statistics
10. Analyze and interpret results

Utilized data to illustrate applications

- Sample size requirements to detect functionally significant differences in properties
  - For design of inventory, assessment and monitoring systems



Poster: Ward et al.

- Comparison of central tendency and variation to determine presence of functionally significant differences in properties
  - To help select indicators
- Relationship of soil and vegetation properties for ESD development

NPS funding for data analyst, ARS-Las Cruces, NM

What’s next?

1. Include laboratory data.
2. Finalize data interpretation for NPS, SS update project and ESD development.
3. Incorporate “lessons learned” with Dynamic Soil Properties Sampling Guide.
4. Conduct new pilots
    1. Streamline methods and sampling design
    2. Methods for forestland, cropland
5. Develop data entry/storage software

Begay Soil
Utah Pilot
Treatment: PGSL
Replicate: 1
Date: 10·27·05