Soil Properties That Distinguish Ecological Sites and States

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Ecological Sites & States

Answer the questions: Why do sites across a landscape vary in kinds and amounts of vegetation? Why do sites differ in response to disturbance & management?
What are Ecological Sites?

• Based on the “site” concept
  - Groupings portions of the landscape based on ecological potential
  - Central tenet of resource management

• Originally “Range Site”
  - From West, prior to completion of NCSS soil surveys
  - Applied by range scientists in areas with little soils information
  - Initially based on vegetation more than soils (inferring soil properties based on assumptions of vegetation dynamics)
What are Ecological Sites?

- **Current concepts:**
  - Group parts of the landscape that have similar potential to produce kinds & amounts of vegetation and respond similarly to disturbance & management
  - Differentiate based on:
    - Soil properties (e.g. % clay in subsoil)
    - Landscape properties (e.g. run-in versus run-off)
    - Climate (e.g. MLRA or LRU)
    - (Need to be field identifiable)
Properties that distinguish Ecological Sites

• Within a climatic zone, those landscape and soil properties that control the inherent potential of site

• Primarily considering properties that have substantial control over four processes:
  - Soil water availability
  - Soil nutrient availability
  - Plant rooting
  - Soil stability and redistribution
Soil Properties of Ecological Sites

- Landscape Position
- Mineralogy/Parent Material
- Surface texture
- Aspect
- Soil Profile
Four example from MLRA 42.2.
Example from MLRA 42.2. Deep versus Shallow Sandy ecological sites, differing resilience to drought.
Ecological Sites & Soil Survey

• Both systems for classifying landscapes into units
  - ES explicitly linked to ecological processes & ecosystem services (interpretation)
  - NCSS based on taxonomy (implicitly link to use or management goals)

• ES related to soil survey at the map unit component level
  - Components correlated to one ES
  - One ES usually correlated to many components
  - Soil series can be correlated to more than one ES (e.g. run-in phase)
Ecological Sites & Soil Mapping

- 50% Berino fine sandy loam, 1-5% slopes = Sandy
- 30% Dona Ana fine sandy loam, 1-5% slopes = Sandy
- 15% Pintura fine sand, 0-5% slopes = Deep sandy
- 40% Stellar clay loam, 0-3% slopes = Clayey
- 40% Stellar clay loam, 0-3% slopes, flooded = Bottomland

- 40% Onite loamy sand, 1-4% slopes = Sandy
- 30% Pajarito fine sandy loam, 0-5% slopes = Sandy
- 50% Berino fine sandy loam, 1-5% slopes = Sandy
- 30% Dona Ana fine sandy loam, 1-5% slopes = Sandy
What are Ecological States?

- Ecological Site Descriptions include descriptions of site ecological dynamics
- State-and-transition models are conceptual diagrams that capture:
  - Range in ecological properties and processes that occur
  - Drivers of transitions and restoration pathways
- STMs are used to develop adaptive management strategies

STMs

- Historic black grama grassland
- Mixed, patchy grassland
- Snakeweed-Mesquite shrubland
- Threeawn-dropseed grassland
- Mesquite coppice shrubland
What defines Ecological States?

• Currently, states primarily defined by plant community properties (e.g. < 10% perennial grass or > 50% shrub cover)

• Can we define dynamic soil properties of states?
  - Soil water availability
  - Soil nutrient availability
  - Plant rooting
  - Soil stability and redistribution
Properties of Ecological States

- Plant community composition
- Soil organic matter
- Soil structure
- Bare ground & canopy cover
- Production
- Soil biota, Biological soil crusts
Example dynamic soil property differing between states

- Shallow sandy loam in southern Utah
- Soil structure very use-dependent
- Vegetation similar, soil biota and soil structure different

Duniway et al. 2010
Research Needs

• Where ES defined:
  - Refinement of soil surveys in areas with low precision mapping, more emphasis on mapping ES?
  - Raster-based ES maps?

• Where ES still in development (or refinement)
  - Soil property-plant community data sets (digital soil mapping?)
  - Ecological state mapping
  - Soil series or MU components that are actually correlated with ecological states? e.g. Copia
Research Needs

• More data on soil properties that define states & predict thresholds
  - Question driven dynamic soil property sampling, how do dynamic soil properties differ between states?
  - Dynamic soil properties as leading indicators of state change?

• Harvesting existing research and data sets that pertain to ecological sites (soils often not identified in ecological literature)

• Ecological sites for croplands? (Skye?)