Ecological Sites: The Development Process

Kendra Moseley-Urbanik
UDSA-Natural Resources Conservation Service
Portland, OR
Ecological Site Concept

- Like a ‘species concept’
- Defines the distinguishing geophysical properties of a site and its STM
- Ecological site and STM development occur together
Ecological Questions
What are the reference conditions for different parts of the landscape and what ecological processes are necessary to maintain the reference condition?

Background Research
An exhaustive review of the literature, expert knowledge, historical documentation and photography, and maps.

Field Reconnaissance
Field reconnaissance covering the entire extent of the MLRA or LRU.

Develop Initial Ecological Site Concepts
A set of working ecological site concepts are developed, including the geophysical characteristics that define the ecological sites and their plant community dynamics. These concepts serve as initial hypotheses.

Test Ecological Site Concepts
Field data are used to test the ecological site concepts

Accepted?
Data support the ecological site concept

Rejected?
Data do NOT support the ecological site concept

Report Results
Develop ecological site descriptions, including ecological site keys, synthesis of data, and management interpretations.

MLRA or LRU

Moseley et al., 2010
Ecological Site Development-Data support

**High intensity characterization**
- Line-point intercept, production
- Dynamic soil properties/indicators
- Monitoring of selected attributes
- Soil pit (1 day per point and possibly revisits)

**Medium intensity inventory (transecting or stratified)**
- Ocular estimates or step/line-point intercept
- Soil surface indicators
- Soil profile properties/mini-pit (1-2 hours per point)

**Low intensity inventory (traverse)**
- Rapid plant community characterization
- Soil surface indicators
- General soil types/soil taxa/ecological sites (15-30 minutes per point)

Focused data collection at reference locations (ideally gathered in the reference community phase)

Targeted data collection stratified using ecological site concepts

Numerous data points to capture full range of site variation

Moseley et al., 2010
Developing Concepts

- Background research
  - How should ecological potential vary across the landscape?
  - Existing mapping of soils, geology, weather & climate, vegetation, hydrology etc.
  - Interview with “local knowledge” experts
  - Historical documentation (survey records, journals and diaries, photos, etc)
  - Science literature, published studies in the area
Developing Concepts

Background research should result in rudimentary groupings of climate zones/elevation zones, parent materials, soil properties, and vegetation and wildlife communities, and provide information on common land uses and management concerns.
Developing Concepts

• Reconnaissance (refining initial concepts)
  - Correlations among soil properties and vegetation
  - Variability in plant community-soil relationships
  - Local knowledge: historical events, vegetation-soil relationships, and the origins of landscape patterns
  - Reference sites (exclosures, airports)
  - Observations across MLRA or LRU
  - Systematic, low intensity records
Developing Concepts

- After research and reconnaissance, develop initial sites concepts
- Initial site concepts represent a hypothesis that can be tested
- Clearly specify the climatic, topographic, and soil properties that distinguish the site from others
Developing Concepts

• Climate
  ▪ Precipitation amounts (averages and extremes)
  ▪ Precipitation timing
  ▪ Temperature (averages and extremes)
  ▪ Growing season (length and relationship to precipitation)
  ▪ Wind speeds
Developing Concepts

- Topographic properties
  - Elevation
  - Aspect
  - Slope
  - Landscape Position
  - Contributing or accepting resources
Developing Concepts

- Soil Properties
  - Surface texture (importance for water infiltration, retention, soil erodibility)
  - Surface modifiers (gravels, stones, boulders, hummocks, etc)
  - Subsoil horizons (texture, type)
  - Depth to root restrictive horizons, water table, or bedrock (type)
  - Chemistry (Sodium, Calcium, Gypsum, etc)
Developing Concepts

• Specify a range in characteristics that vary at different spatial scales
  ▪ Relatively fine scales of soil properties
  ▪ Broader scale elevation and climatic variations
Developing Concepts

- Existing vegetation can not be a primary ecological site criterion because it is easily manipulated therefore highly variable.
- Nonetheless, certain species can be used to assist in ecological site definition and identification because they provide clues to soil and climatic conditions.
- The ecological site concept should be developed, using geophysical attributes that enable identification of the ecological site without vegetation on the site.
Developing Concepts

- Where changes in soils, aspect, topography, or moisture conditions are abrupt, boundaries of the ecological site will be obvious.
- Where these factors change gradually along broad environmental gradients, ecological site distinctions are more difficult to identify and may require data collection before solid ecological site concepts can be developed.
Developing Concepts

Sandy mixed, thermic Entic Haploxeroll

Sand Hills

Gravelly Sand Hills

Sandy Bottoms

Mixed, thermic Typic Xeropsamment

Sandy-skeletal, mixed, thermic Entic Haploxeroll
Developing Concepts

- Ecological site concepts are multivariate constructs. They are built from the relationships of several, interacting attributes that collectively produce similar environments for plant communities, similar ecological dynamics, and similar response to disturbances.
## Example ecological site concepts

<table>
<thead>
<tr>
<th>Preliminary Ecological Site</th>
<th>Elevation (ft)</th>
<th>Landform</th>
<th>Geology</th>
<th>Aspects</th>
<th>Slopes</th>
<th>Soil Texture</th>
<th>Soil Depth</th>
<th>Dominant Reference Vegetation</th>
<th>Data Collection Needs?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1500 – 3500</td>
<td>Mountains</td>
<td>Granite</td>
<td>South West</td>
<td>Steep</td>
<td>Sandy</td>
<td>Deep</td>
<td>Chamise-Buckbrush</td>
<td>High variation – extensive data needs</td>
</tr>
<tr>
<td>2</td>
<td>1200 – 3800</td>
<td>Mountains</td>
<td>Granite</td>
<td>North East</td>
<td>Steep</td>
<td>Loamy Sand</td>
<td>Moderately Deep</td>
<td>Bigberry manzanita-Scrub oak</td>
<td>High variation – extensive data needs</td>
</tr>
<tr>
<td>3</td>
<td>500 – 1000</td>
<td>Upper Stream Terraces</td>
<td>Rhyolite</td>
<td>Neutral</td>
<td>Flat</td>
<td>Sandy Clay Loam</td>
<td>Deep</td>
<td>Valley oak-Sedge</td>
<td>Low variation – minimum data needs</td>
</tr>
<tr>
<td>4</td>
<td>1500 – 3500</td>
<td>Footslopes</td>
<td>Volcanic Breccia</td>
<td>North East</td>
<td>Steep</td>
<td>Sandy Loam</td>
<td>Shallow to bedrock</td>
<td>Hollyleaf cherry-Toyon</td>
<td>High variation – extensive data needs</td>
</tr>
</tbody>
</table>
Testing ecological site concepts

Focused data collection at reference locations (ideally gathered in the reference community phase)

High intensity characterization
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  (1 day per point and possibly revisits)

Targeted data collection stratified using ecological site concepts

Medium intensity inventory (transecting or stratified)
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  (15-30 minutes per point)
How do we decide the ecological sites to be recognized?

Ability to **produce** kinds, amounts and proportions and in **response** to disturbance:

- Abiotic factors that influence plant production, composition, ecological processes.
- Significant differences in presence of species or species groups.
- Significant differences in relative proportion of species or species groups.
- Significant differences in total annual production.
- Significant differences in responses to management actions or disturbance processes.

USDA-NRCS NRPH (2007); IESHR (Draft)
Testing ecological site concepts

• Systematic inventories of two types:
  – Stratified random based on repeated samples of different ecological site delineations, especially those for which data are needed
  – Areas deliberately selected due to information contained in them (e.g., reference areas, degraded areas, areas with known management histories connected to local knowledge)
Testing ecological site concepts

• Stratified random inventory:
  – GIS layers (DEM, geology, soils, imagery) used to estimate locations of ecological sites and random points are selected
  – Google Earth and NASA WorldWind
  – Replication sufficient to build statistical models
  – Samples can be clustered (transecting or groups)
  – Samples can be stratified by landscapes
Testing ecological site concepts

Modified Domin-Krajina cover estimate in 20x20 m plot

<table>
<thead>
<tr>
<th>Woody Class</th>
<th>Grass Class</th>
<th>Forb Class</th>
<th>Other Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>+-- few</td>
<td>1--&lt;0.1%</td>
<td>2--&lt;1%</td>
<td>3--1-4%</td>
</tr>
<tr>
<td>+-&lt;0.2m2</td>
<td>1--0.2-0.5m2</td>
<td>2--0.5-4m2</td>
<td>3--4-20m2</td>
</tr>
</tbody>
</table>

Link observations of vegetation and soils: cover estimated ocularly or using LPI, but must be quick enough to get replication

20 m = 1/10th acre plot

or

Line-point intercept, 50 cm spacing

Percent Scale

Litter
Cryptogram
Testing ecological site concepts

Vegetation and soils data must be databased together (JER and others have used the DIMA database)
Testing ecological site concepts

Larrea cover has complex relationships to clay and carbonate in argillic horizon
Testing ecological site concepts

Three ecological sites potentially represented in this sample

Limy gravelly

Gravelly

Gravelly loam
Testing ecological site concepts

Inventory data support existence of alternative states (12% creosotebush canopy cover is a good break)
Testing ecological site concepts

Historical evidence tied to inventory: in the 1850s, evidence of grass-dominated and Larrea-dominated patches in area: which soil?
Soil-site correlation

Nickel-Tencee-Delnorte complex, moderately sloping, soil map unit

<table>
<thead>
<tr>
<th>Soil map unit component</th>
<th>Ecological Site</th>
<th>MLRA</th>
<th>LRU</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nickel very fine gravelly sandy loam</td>
<td></td>
<td>042X</td>
<td>B</td>
<td>Gravelly</td>
</tr>
<tr>
<td>Del Norte gravelly loam</td>
<td></td>
<td>042X</td>
<td>B</td>
<td>Gravelly</td>
</tr>
<tr>
<td>Tencee very gravelly sandy loam</td>
<td></td>
<td>042X</td>
<td>B</td>
<td>*Limy gravelly</td>
</tr>
</tbody>
</table>

*proposed new site
Soil-site correlation “rules”

An **ecological site** can include more than one soil series, provided that the soils are similar.

A **soil map unit** can include more than one ecological site. Soil map units often include many different soils, with different potentials to support plant communities.

Even a **soil series** can include more than one ecological site. Soil surface texture often varies within a soil series. Soil surface texture is very important in distinguishing ecological sites.
High intensity Samples

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High intensity Samples

20m x 20m plot, one stratum, four soil subsamples

- Baseline, 20 m long
- Transect, 20m long
- Herbaceous production subplot, 1m-sq
- Woody production subplot, 100m-sq
- Soil subsample
- Soil subsample, full pedon description
- Soil stability sample

- Three replicates per state per site
- Consider monitoring to document temporal variations due to climate
Develop interpretations

• High intensity data and other data:
  – Domestic animal uses/forage
  – Wildlife habitat (by state or community)
    (see Holmes and Miller, JWM, 2010)
  – Hydrologic functions
  – Recreation
  – Future options (carbon sequestration, dust control, more detail on wildlife habitat)
Thank you!