



General concepts in the development and use of ecological site descriptions

Brandon Bestelmeyer

Jornada Experimental Range

Las Cruces, NM, USA

bbestelm@nmsu.edu

Ecological Site:

“a distinctive kind of land based on recurring soil, landform, geological, and climate characteristics”

Divides landscapes into basic units for study, evaluation, and management

Ecological Site Description:

Reports with associated data that document the characteristics of an ecological site and the interpretation of its properties related to use and management.

Ecological site descriptions have four parts

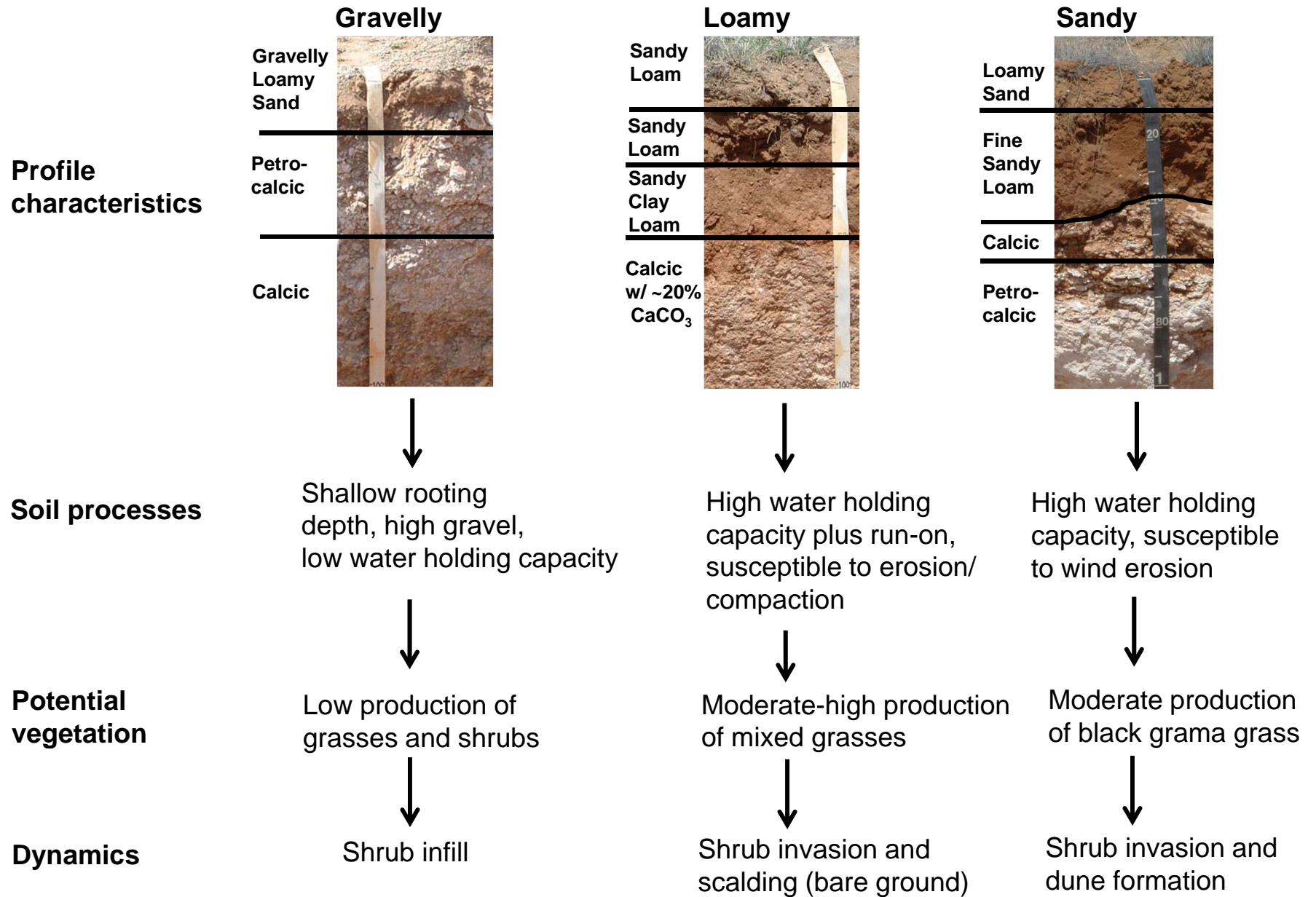
Physical Characteristics -- Distinguishing physiographic, climate, soil, and hydrological features of the ecological site, including variability

Vegetation Dynamics – State-and-transition model narratives and data

Interpretations – Ecosystem services provided by the site and its states, currently focused on grazing uses and sometimes wildlife, but could be expanded

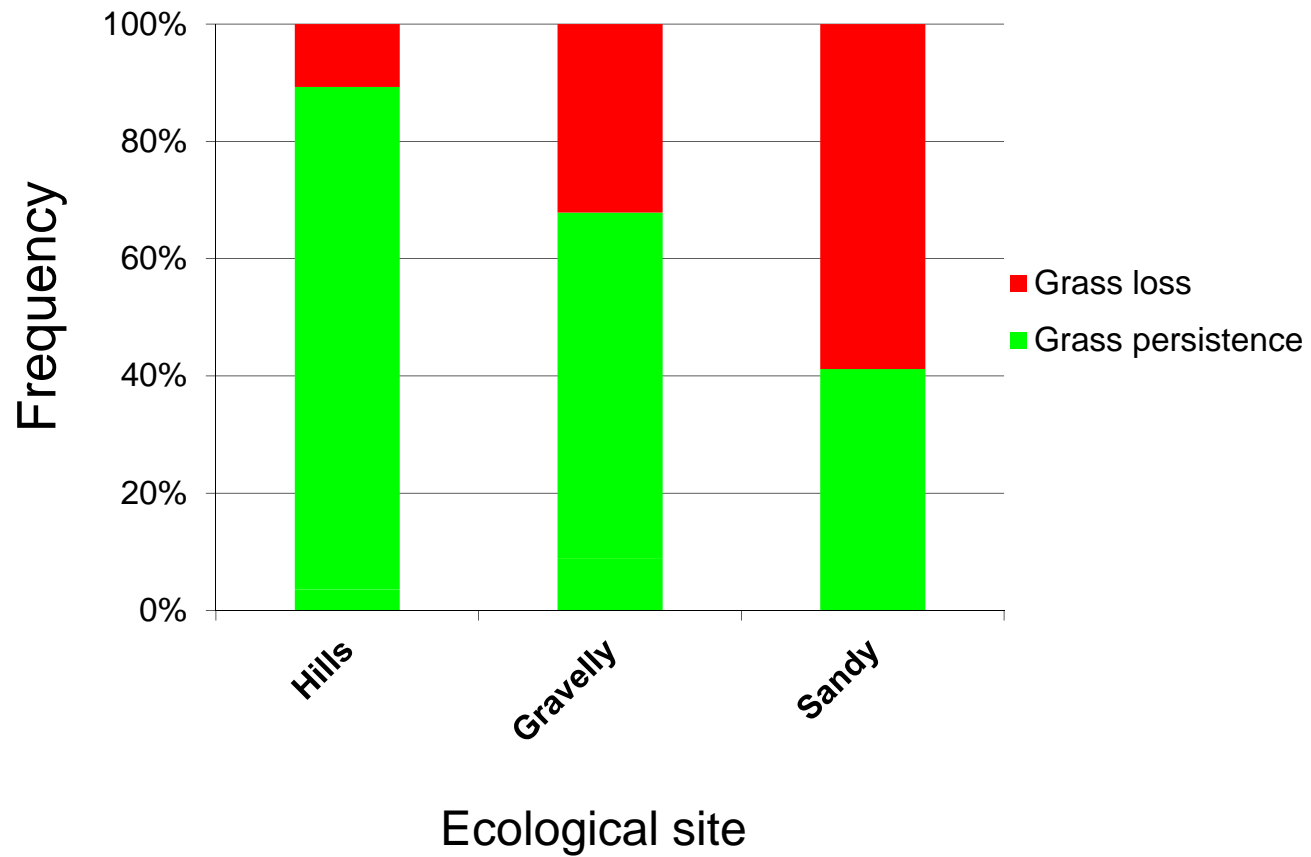
Supporting Data – Provides information on sources of information and data utilized in developing the site description

“Concepts” for three ecological sites

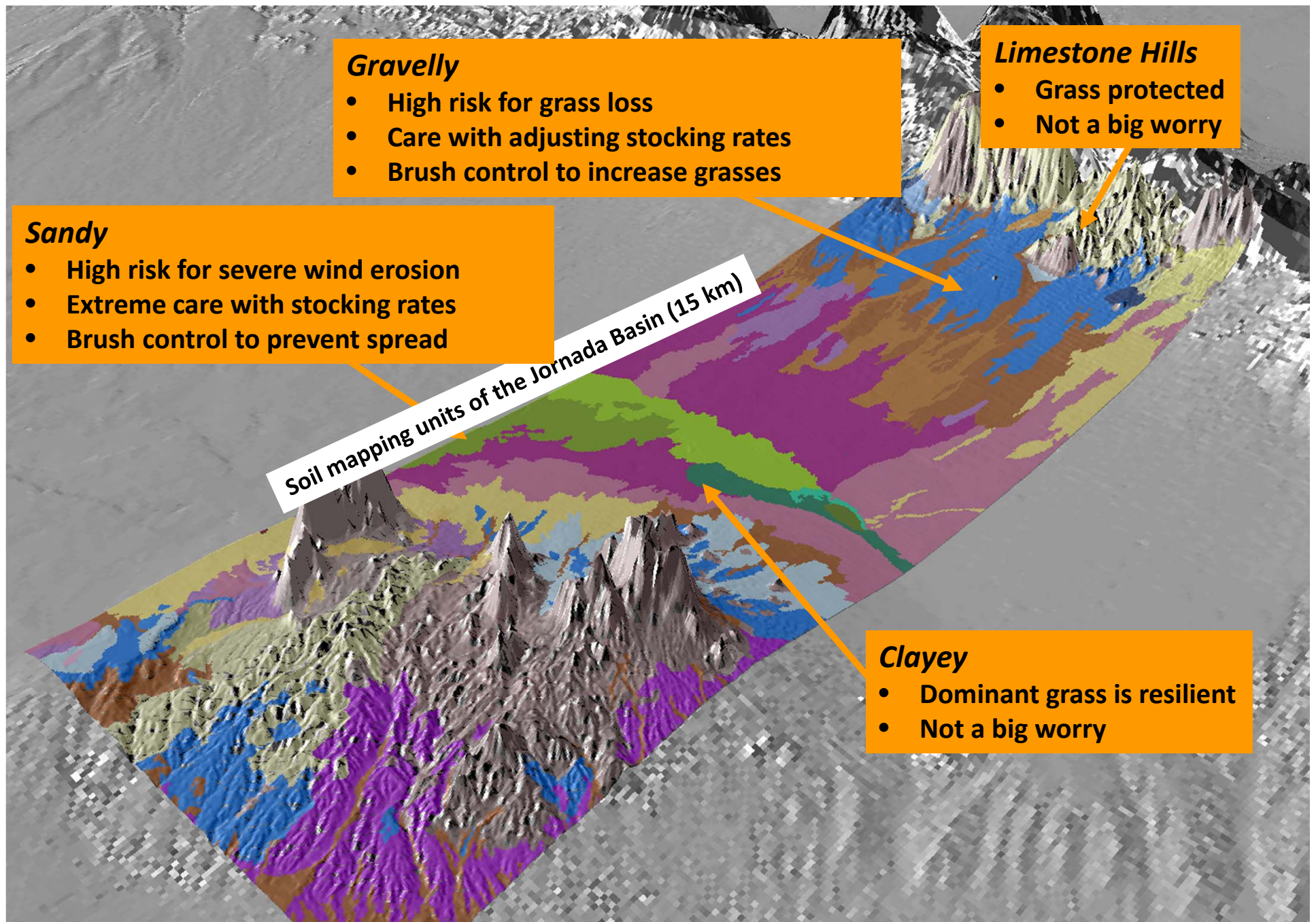


Monitoring data from different ecological sites

Changes in perennial grass cover in 123 trend plots: ca. 1970-2003



Ecological sites in a landscape: management interpretations



History of ecological sites

Forest site: “an area considered as to its physical factors with reference to forest producing power, or the combined effect of the climatic and edaphic conditions of the forest habitat” (Korstian 1919)

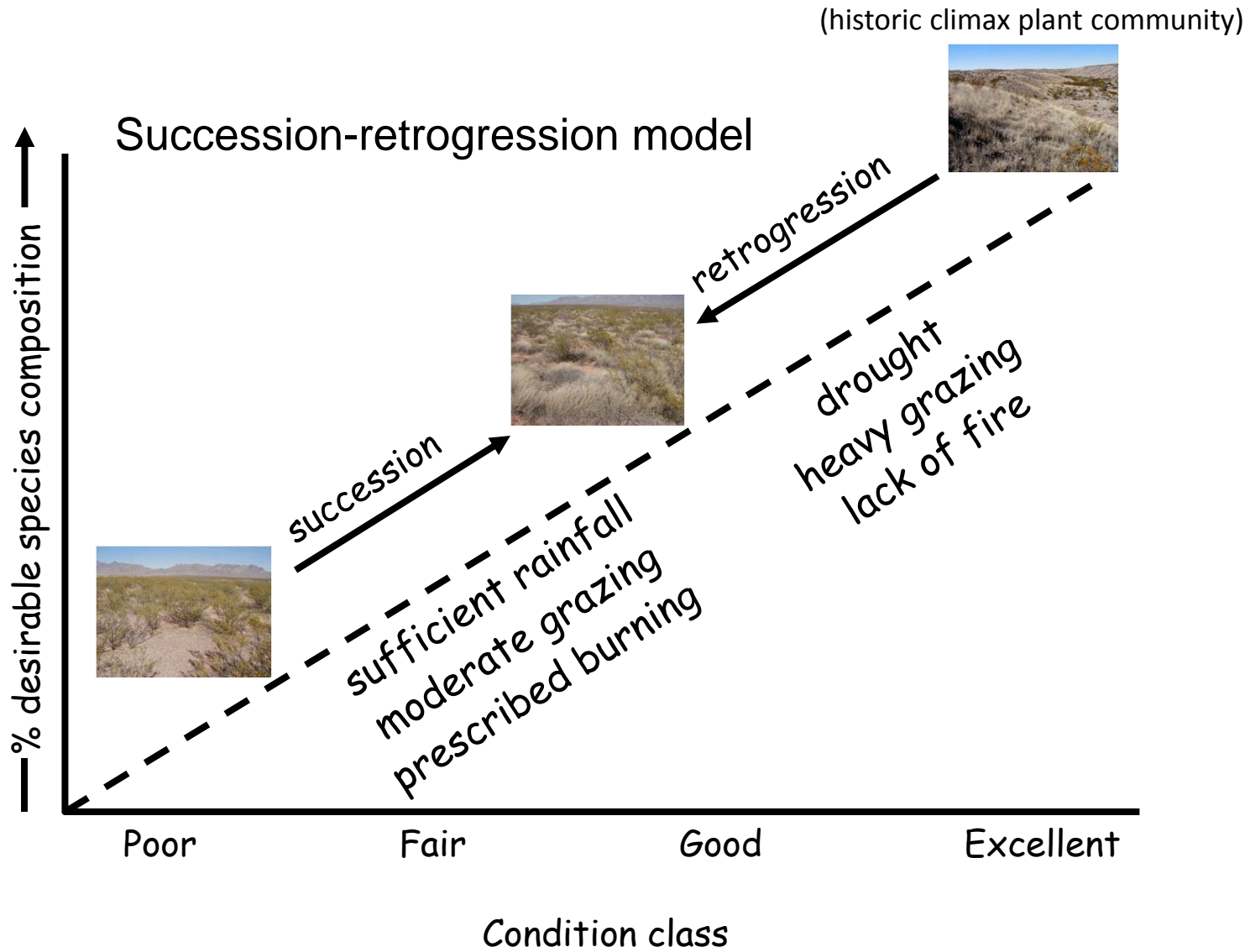


“The units of the physical environment that are mappable and that also subtend a significant difference in kind or amount of climax vegetation are termed “*range sites*”.

“Different portions of... a site are occupied by different plant communities in response to different grazing treatments. Stable (climax) community composition of each site, expressed as relative coverage or annual growth by species, becomes our measure of potential productivity (Dyksterhuis 1958)

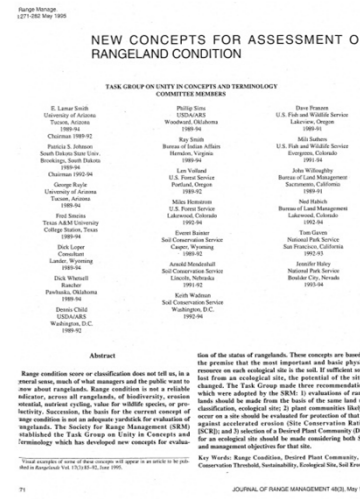
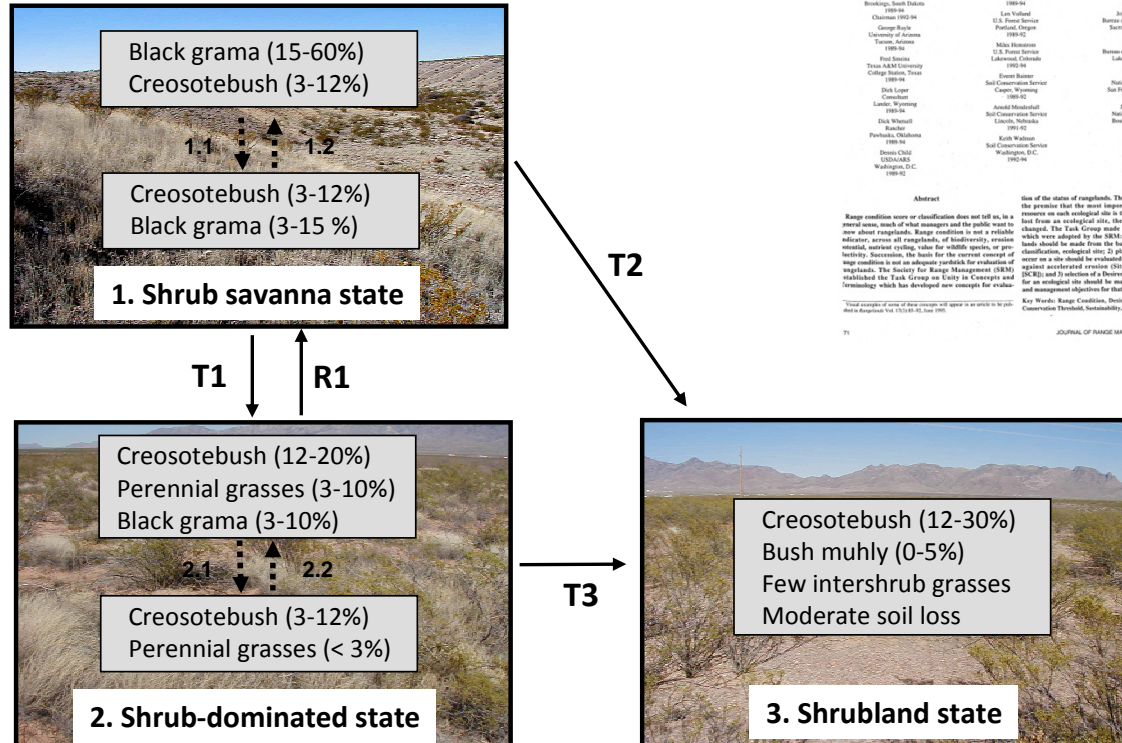


History of ecological sites



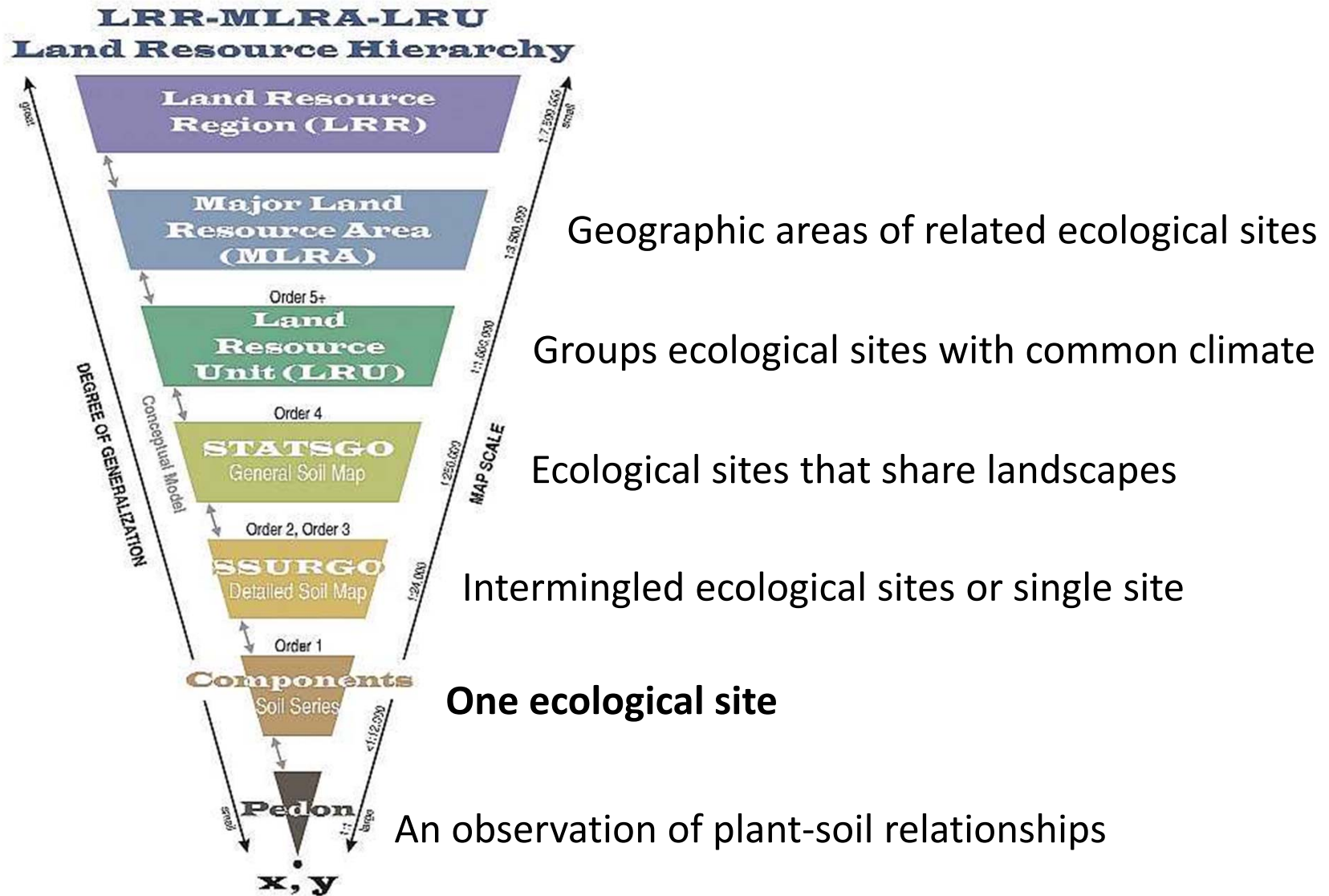
History of ecological sites

State-and-transition model



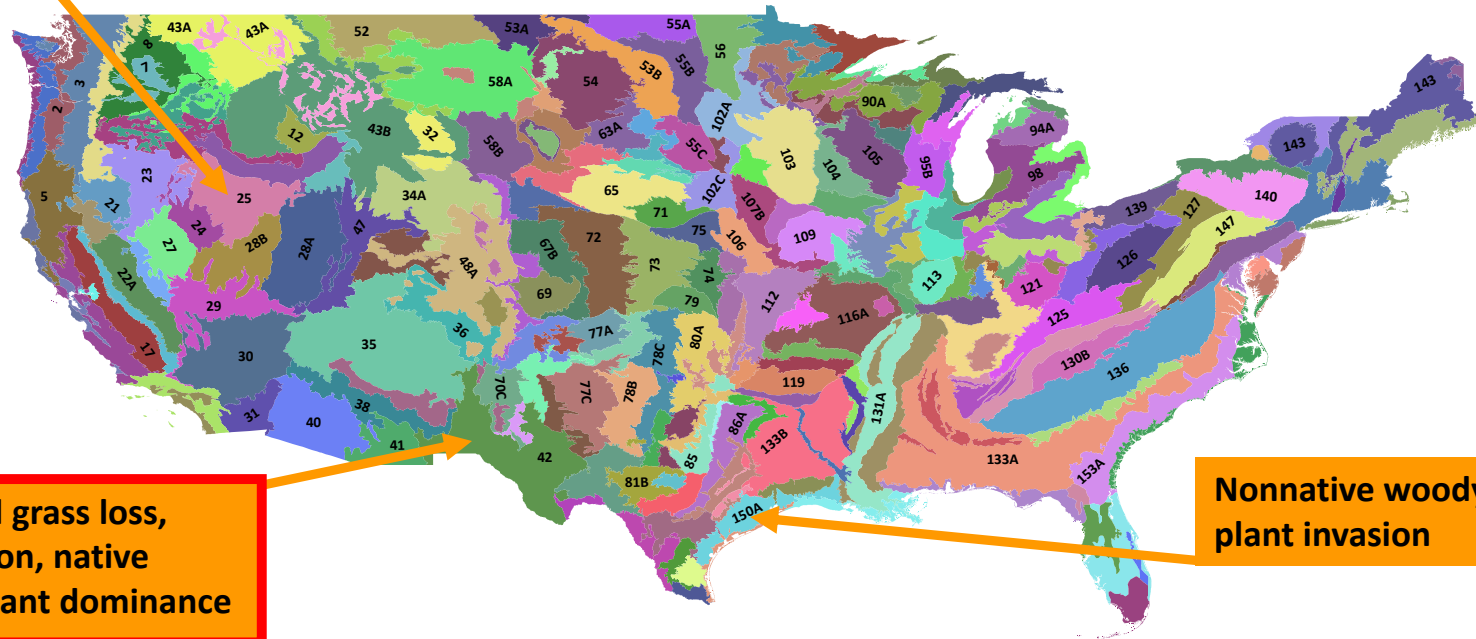
- Alternative states potentially occupy a site
- Emphasis on dynamic soil properties as a basis for sustainability
- ‘Thresholds’ of rangeland health and early warning indicators

Basics of ecological site development: spatial hierarchy



Step 1. MLRAs contain a set of related ecological sites
-similar regional climate, suites of soils, and natural resource issues

**Non-native grass invasion,
increased fire frequency,
loss of native woody plants**



**Perennial grass loss,
soil erosion, native
woody plant dominance**

**Nonnative woody
plant invasion**

Major Land Resource Areas of the continental USA

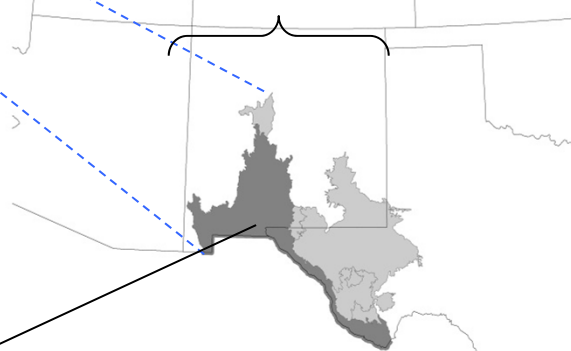
Step 1. Sometimes LRUs subdivide an MLRA based on local climate

-LRUs then contain a set of associated ecological sites

-in some MLRAs, LRUs are not mapped (due to elevation/aspect variations)



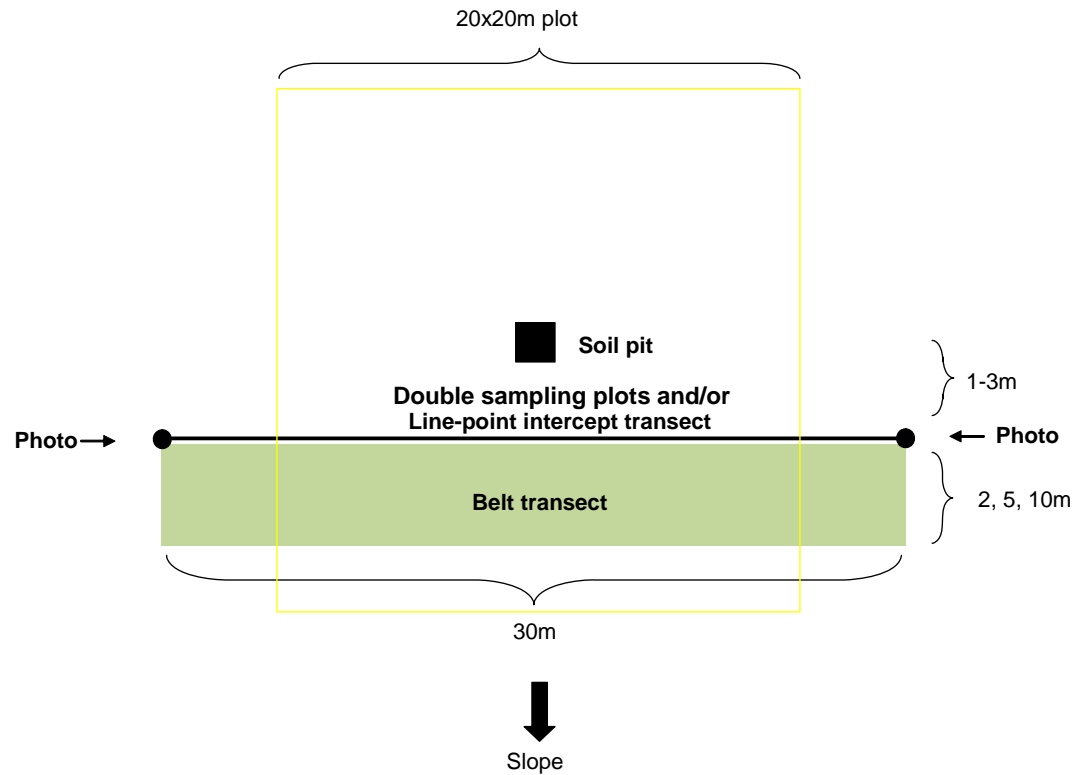
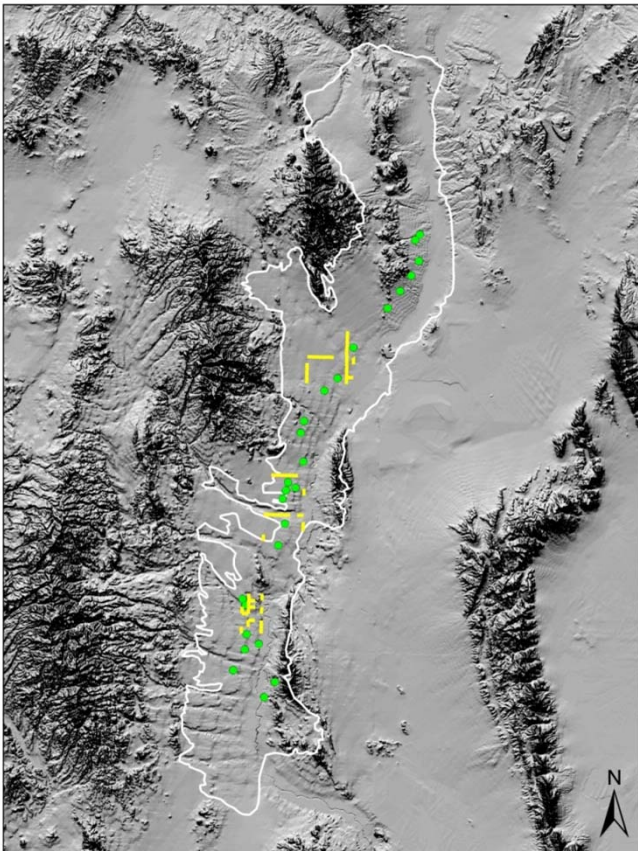
MLRA 42 (Southern Desertic Basins, Plains, and Mountains)



MLRA 42.2 (Chihuahuan Desert Shrubs): 8-10" (typic aridic thermic)

Step 2. Use inventory to test ecological site concepts

- initial research and reconnaissance to develop ecological site concepts (with soil mapping)
- gather data on vegetation and soil profile variables
- use data to examine and revise ecological site classification



Step 2. Soil-landscape variables used to classify ecological sites



Slope and aspect



Water table depth



Flooding duration



Soil texture
(by depth)

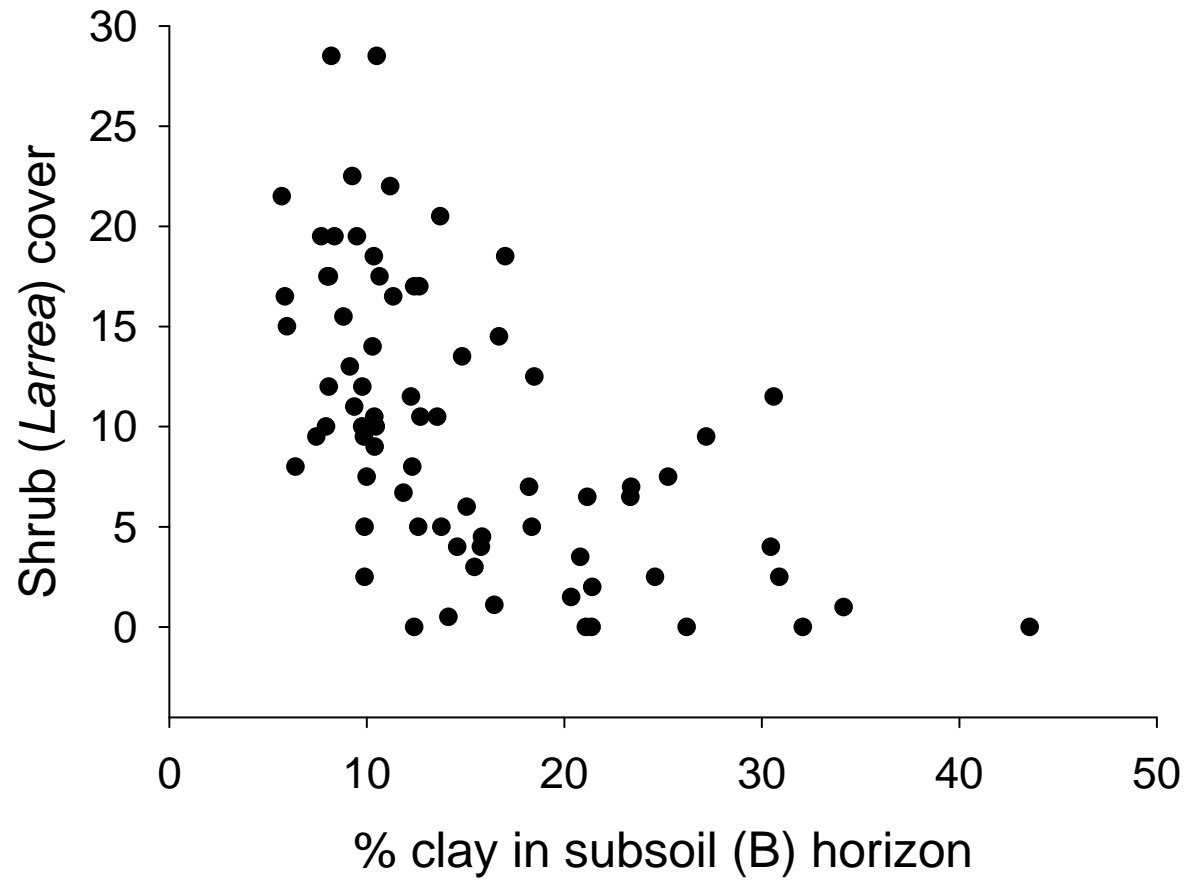


Soil chemistry
(gypsum, sodium)

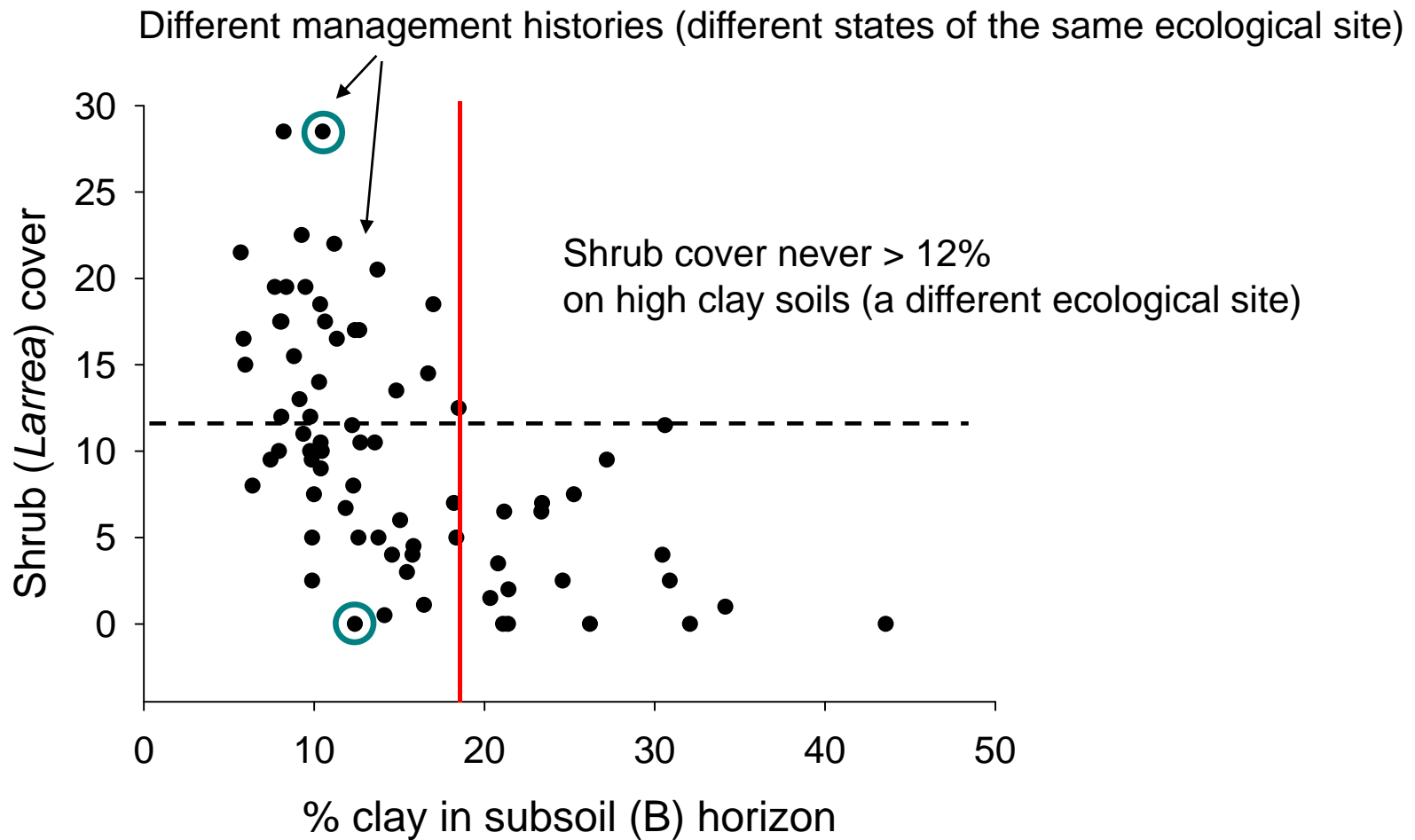


Soil depth
(kind of restrictive horizon)

Step 3. Testing ecological site concepts



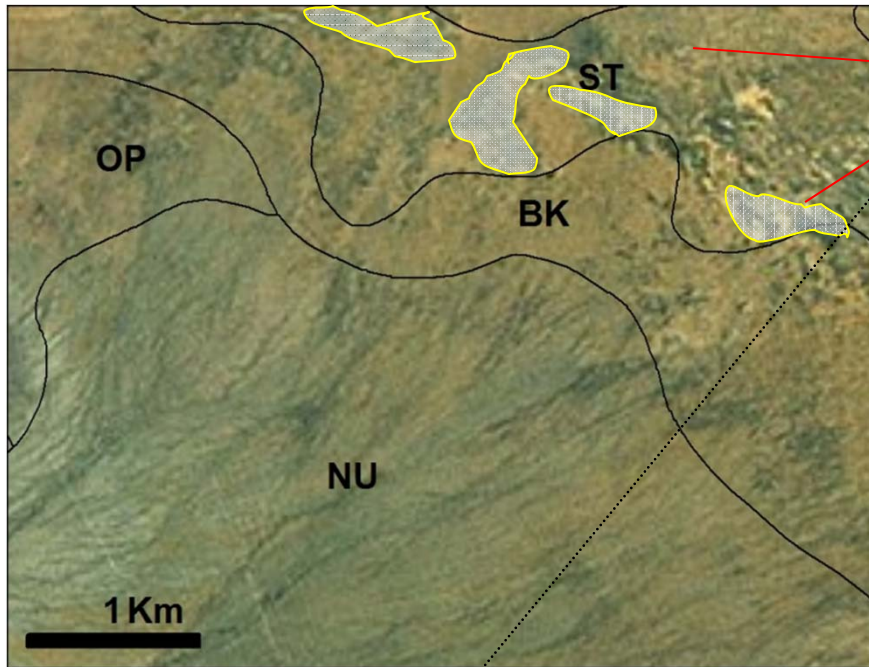
Step 3. Analysis as a learning process



Data support recognition of two different ecological sites

Step 4. Correlation of soil map unit components to ecological sites

Soil-site correlation rules

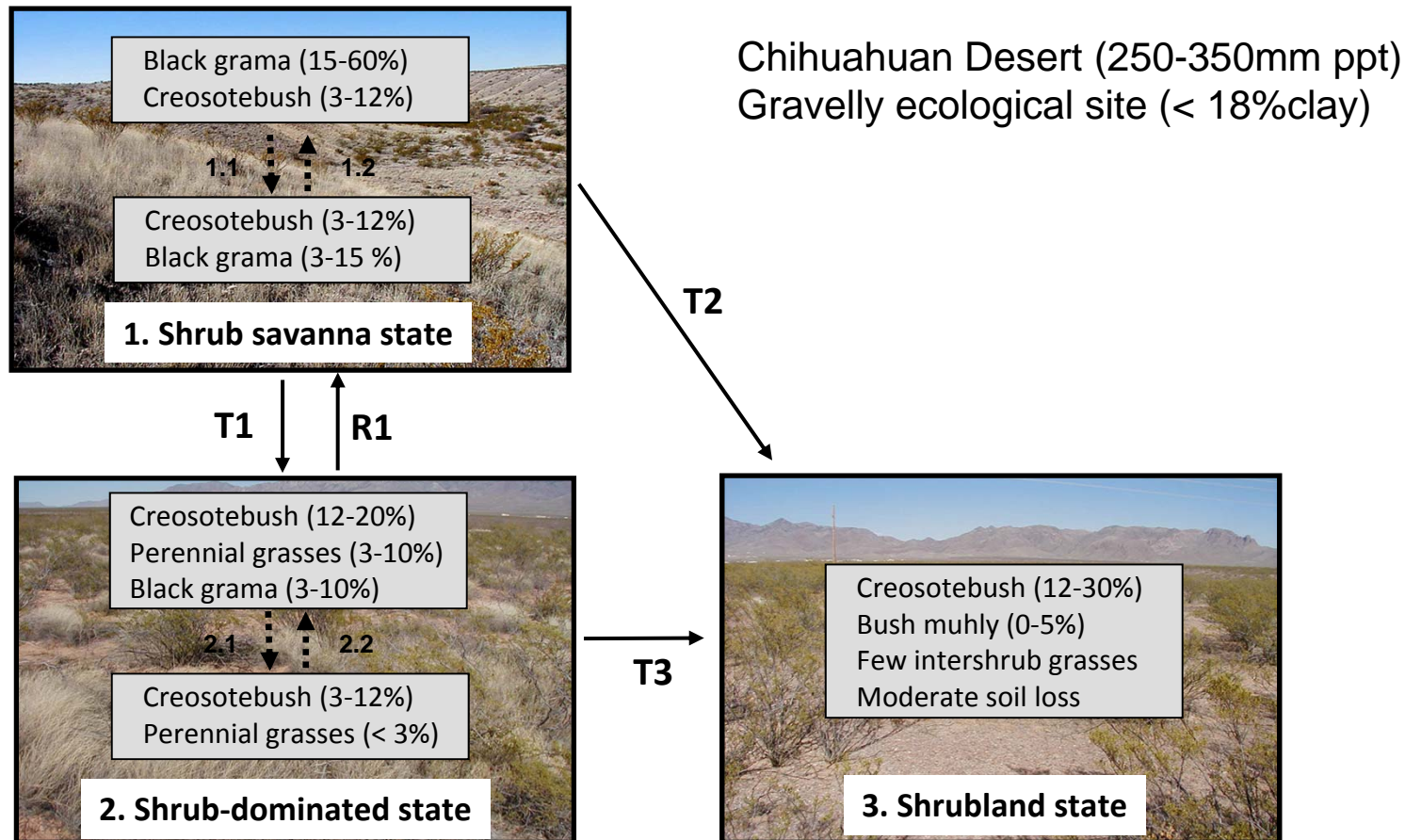


Map unit/components	Ecological site
ST: Stellar association	
40% Stellar clay loam, 0-3% slopes	= <i>Clayey</i>
40% Stellar clay loam, 0-3% slopes, flooded	= <i>Bottomland</i>
20% other inclusions	
BK: Berino-Dona Ana association	
50% Berino fine sandy loam, 1-5 % slopes	= <i>Sandy</i>
30% Dona Ana fine sandy loam, 1-5% slopes	= <i>Sandy</i>
20% other inclusions	
OP: Onite-Pajarito association	
40% Onite loamy sand, 1-4% slopes	= <i>Sandy</i>
30% Pajarito fine sandy loam, 0-5% slopes	= <i>Sandy</i>
15% Pintura fine sand, 0-5% slopes	= <i>Deep sandy</i>
15% other inclusions	

A soil map unit can contain more than one ecological site

An ecological site groups several similar soil map unit components

Step 4. Develop state-and-transition models for each site



T1. Continuous heavy grazing, thinning and patchy loss of black grama, shrub proliferation.

R1. Shrub control followed by grazing deferment and adequate rainfall for black grama recovery

T2. Catastrophic loss of nearly all grasses with high stocking densities in drought periods, followed by loss of soil organic matter, shrub infill, and soil erosion.

T3. Loss of remaining interspace grasses, gradual loss of soil organic matter, infill of shrubs, and soil erosion

Step 4. Information sources for STMs

1. Medium-intensity inventory (what are variations observed on the same soils)

2. Reconstructions of historical vegetation changes

- interviews, experiences of locals**
- ground photography**
- aerial photography**
- monitoring data (BLM trend plots)**

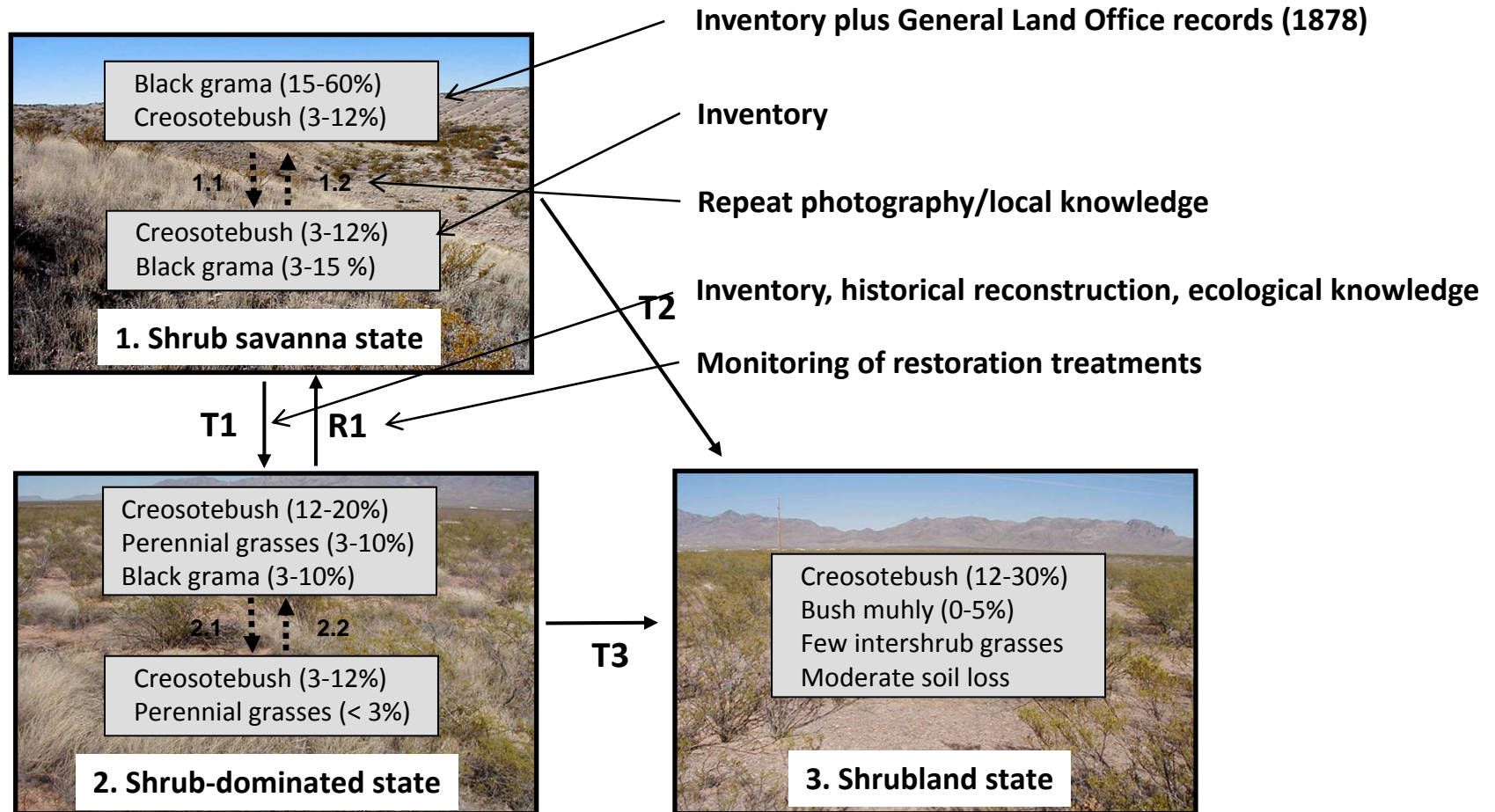
often requires soil sampling to associate data to an ecological site

3. Experimental manipulations and ecological processes

- published literature, might be generalized to multiple ecological sites**
- especially needed for describing ecological mechanisms**

4. High intensity inventory (what are ecosystem services provided by states?)

Step 4. Information sources for STMs



Step 5: Develop interpretations

High intensity inventory in representatives of each state

- Production, cover, height by species
- Dynamic soil properties (bulk density, soil organic matter content)
- Monitoring, preferably through a dry-wet or fire succession cycle

Medium-intensity inventory and existing data/literature

- Production ranges/growth curves
- Wildlife habitat (by state or community)
- Hydrologic functions
- Recreation

Future options (carbon sequestration, dust control, more detail on wildlife habitat)

There are general ecological processes at work



Melaleuca-Baumea community
Wetland Ecological Site
Swan Coastal Plain Bioregion



Banksia attenuata-Hibbertia
community (burned)
Sand Dune Crest Ecological Site
Swan Coastal Plain Bioregion

Western Australia