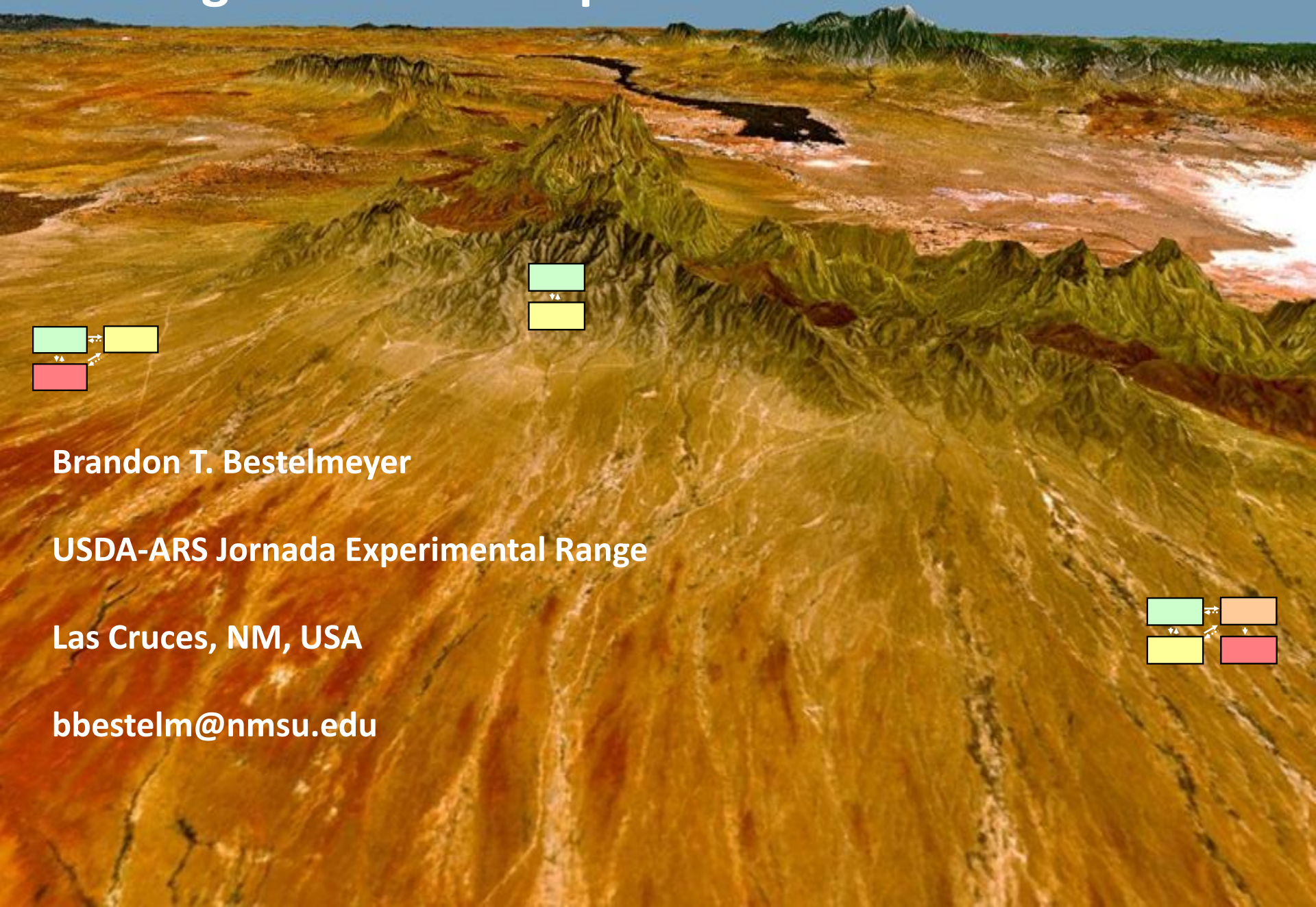
Ecological Site Descriptions: A Primer



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Ecological Site:

A distinctive kind of land with specific physical characteristics that differs from other kinds of land in its ability to produce a distinctive kind and amount of vegetation, and in its ability to respond to management actions and natural disturbances.

Ecological Site Description:

Reports with associated data that document the characteristics of an ecological site (including its climate, soils, and state-and-transition model) and the interpretation of its properties related to use and management.

History of ecological sites

The forest site (yes, the idea came initially from an employee of the USFS)

C. F. Korstian (1919) “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”

Focus on potential and climax plant community as the basis for managing forest

Used in estimating forest timber production and guidance for species mixes for reseeding sites

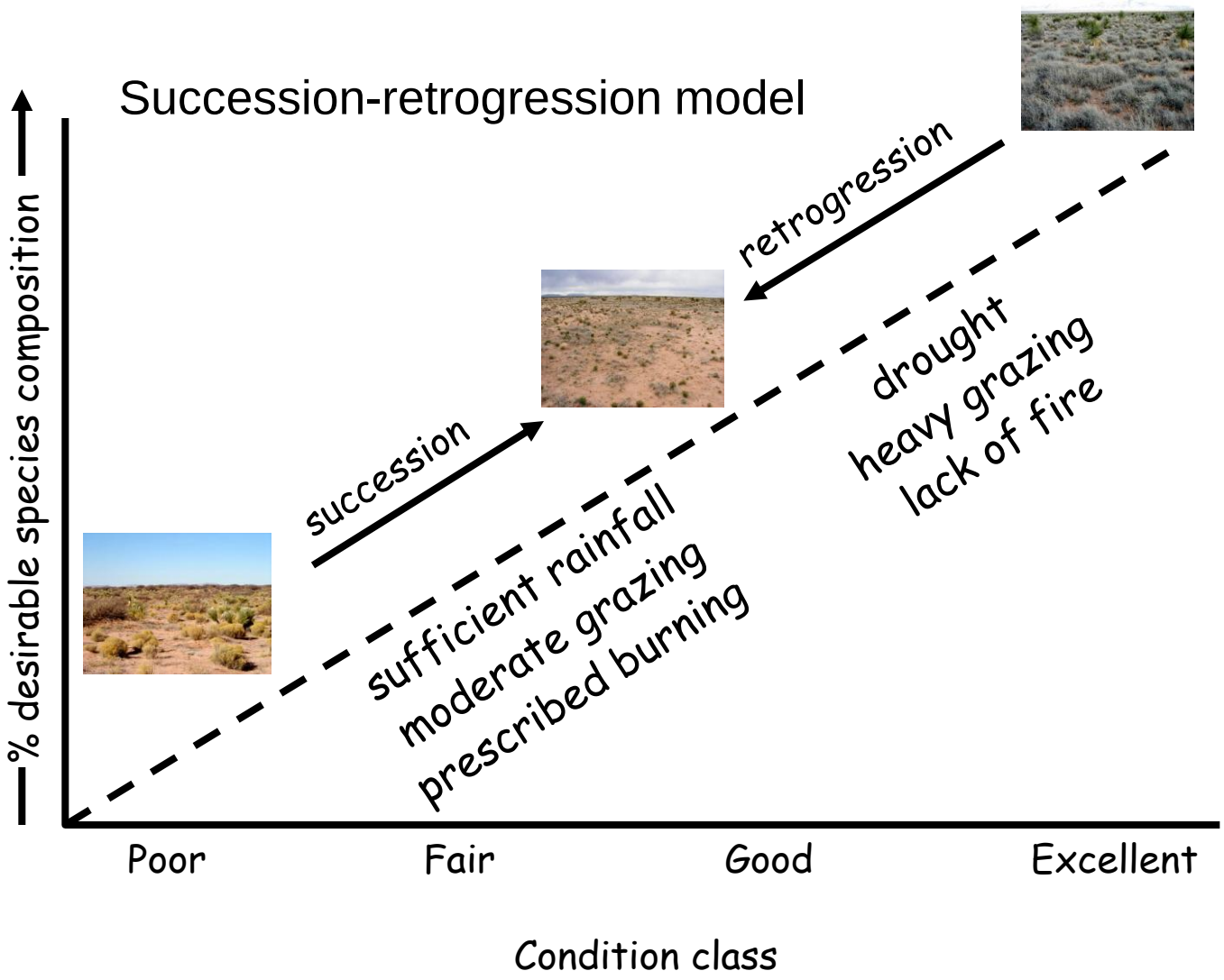
History of ecological sites

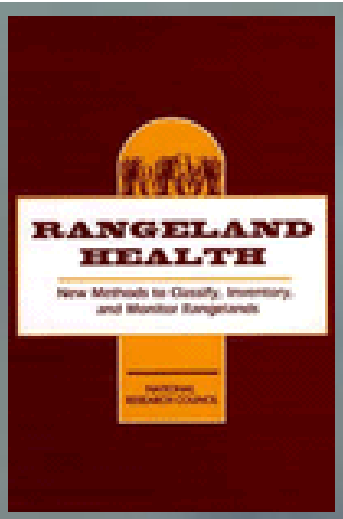
Range Condition/Range Sites

"Different kinds of rangeland are referred to as range sites…Site is not to be confused with type, because many types of vegetation may successfully occupy the same range site in response to different grazing treatments. Current range condition can be measured only in relation to some known potential condition and the only certain indicator of potential is the site". (Dyksterhuis 1953)

- Set long term carrying capacity
- Plant succession as a basis for assessment
- Dynamics with regard to factors affecting livestock forage

History of ecological sites





National Research Council (1994)

Range Manage
1277-282 May 1995

NEW CONCEPTS FOR ASSESSMENT OF RANGELAND CONDITION

TASK GROUP ON UNITY IN CONCEPTS AND TERMINOLOGY
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Abstract

Range condition score or classification does not tell us, in a general sense, much of what managers and the public want to know about rangelands. Range condition is not a reliable indicator, across all rangelands, of biodiversity, erosion potential, nutrient cycling, value for wildlife species, or productivity. Succession, the basis for the current concept of range condition is not an adequate yardstick for evaluation of rangelands. The Society for Range Management (SRM) established the Task Group on Unity in Concepts and Terminology which has developed new concepts for evaluation of the status of rangelands. These concepts are based on the premise that the most important and basic physical resource on each ecological site is the soil. If sufficient soil is lost from an ecological site, the potential of the site is changed. The Task Group made three recommendations, which were adopted by the SRM: 1) evaluations of rangelands should be made from the basis of the same land unit classification, ecological site; 2) plant communities likely to occur on a site should be evaluated for protection of that site against accelerated erosion (Site Conservation Rating, [SCR]); and 3) selection of a Desired Plant Community (DPC) for an ecological site should be made considering both SCR and management objectives for that site.

Key Words: Range Condition, Desired Plant Community, Site Conservation Threshold, Sustainability, Ecological Site, Soil Erosion

*Visual examples of some of these concepts will appear in an article to be published in Rangelands Vol. 17(1):85-92, June 1995.

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SRM Unity in Concepts and Terminology (1995)

- Multiple plant communities can occupy a site
- They may have similar or differing ability to protect a site from accelerated erosion
- Plant communities may have a variety of values in addition to offering site protection
- Refer to ideas of 'threshold' of rangeland health, multiple stable states, at risk conditions, and early warning indicators as organizing principles

The functions of modern ecological sites

1. Stratify the landscape according to varying ecological potential in order to identify management and restoration targets

2. Assess the risk of persistent degradation and take proactive measures to avoid it

3. Specify constraints to, and opportunities for, desired ecosystem change based on a knowledge of ecological processes

4. Identify specific intervention strategies that can promote desired conditions

5. Design and interpret monitoring based on interventions and expected responses.

What do ecological site descriptions need to contain or link to?

1. Accurate linkages of soil classification and mapping to potential vegetation and ecosystem services

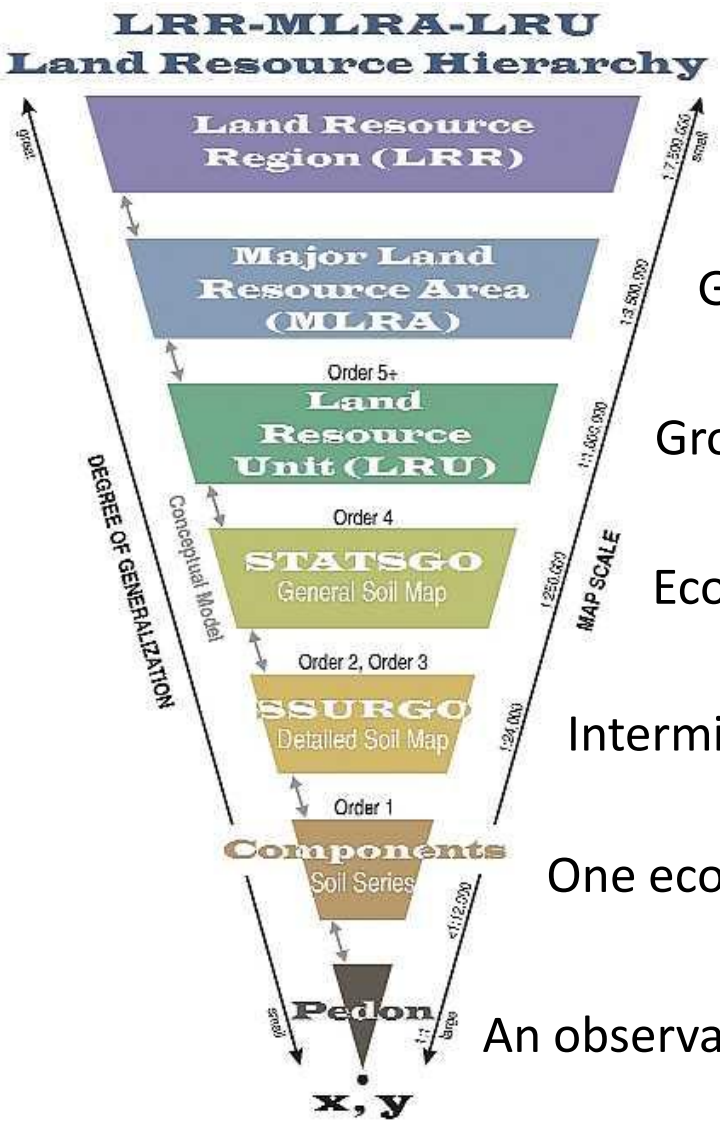
2. State-and-transition models linked to early-warning indicators

3. State-and-transition models that describe ecological thresholds

4. Linkage to specific within-state management and restoration technologies

5. Maps or spatial information on states within sites for monitoring

Basics of ecological site development: scales



Geographic areas of related ecological sites

Groups ecological sites with common climate

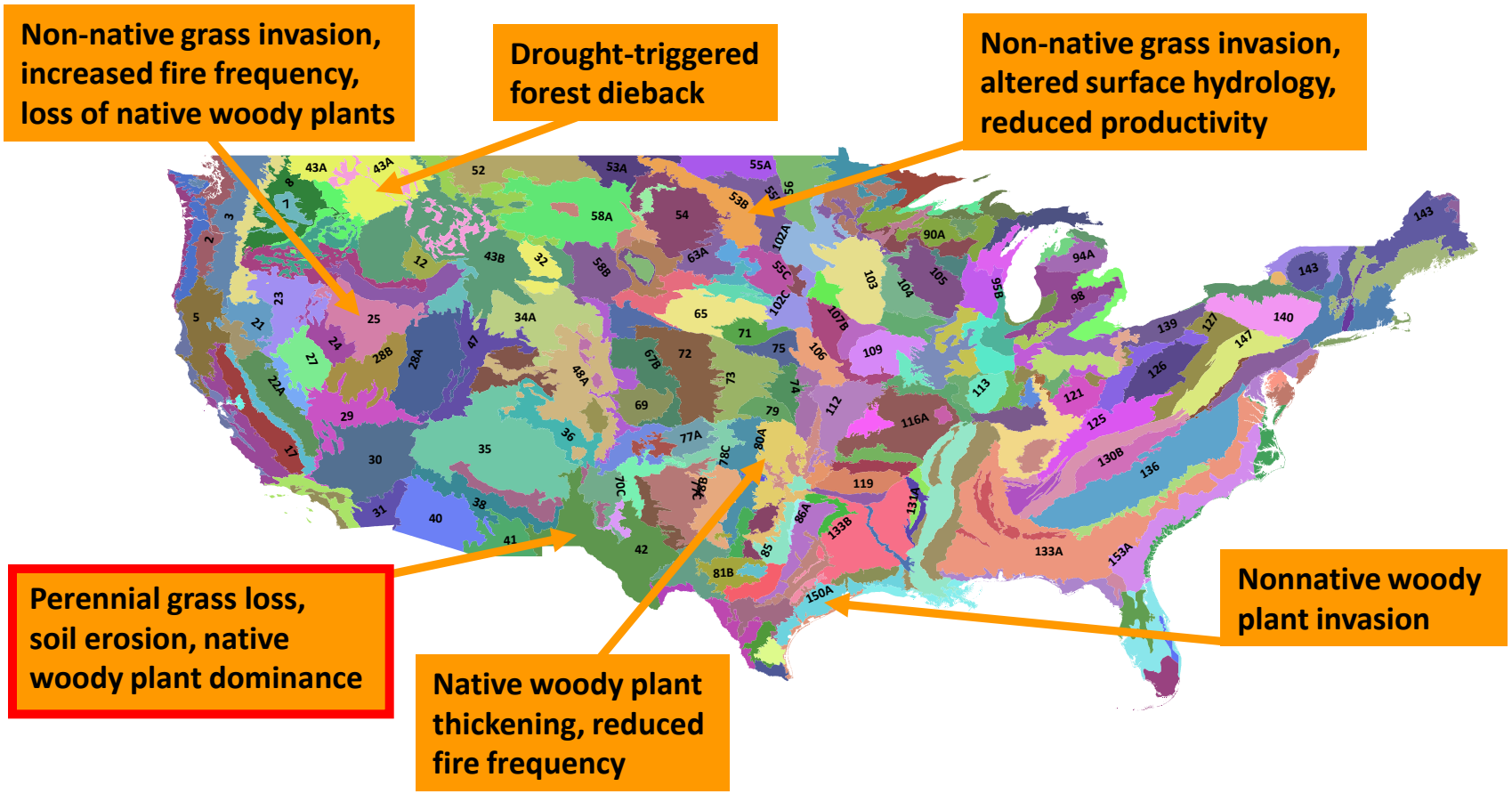
Ecological sites that share landscapes

Intermingled ecological sites or single site

One ecological site or one representative of the site

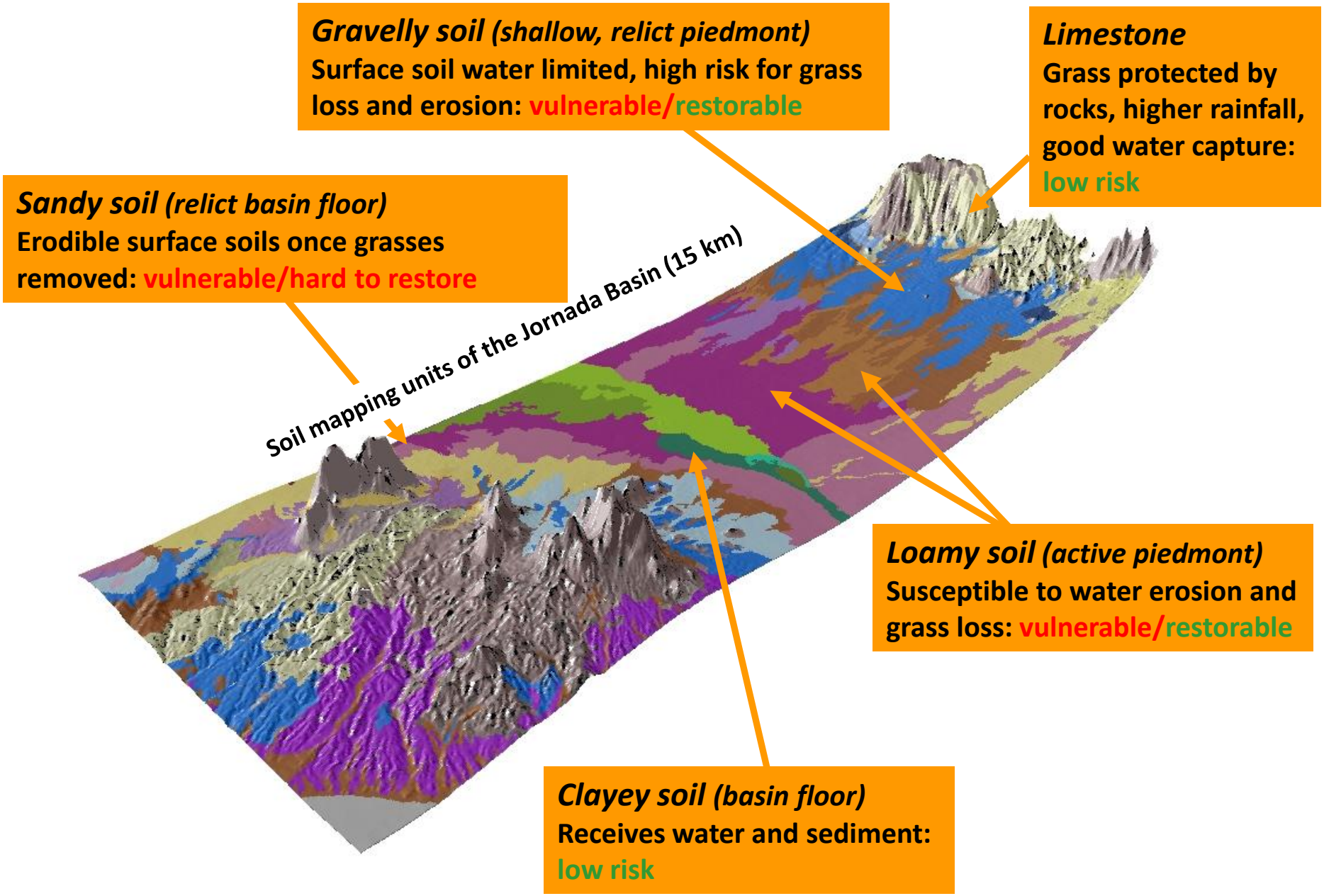
An observation of plant-soil relationships

MLRAs distinguish broad differences in potential and types of ecological dynamics

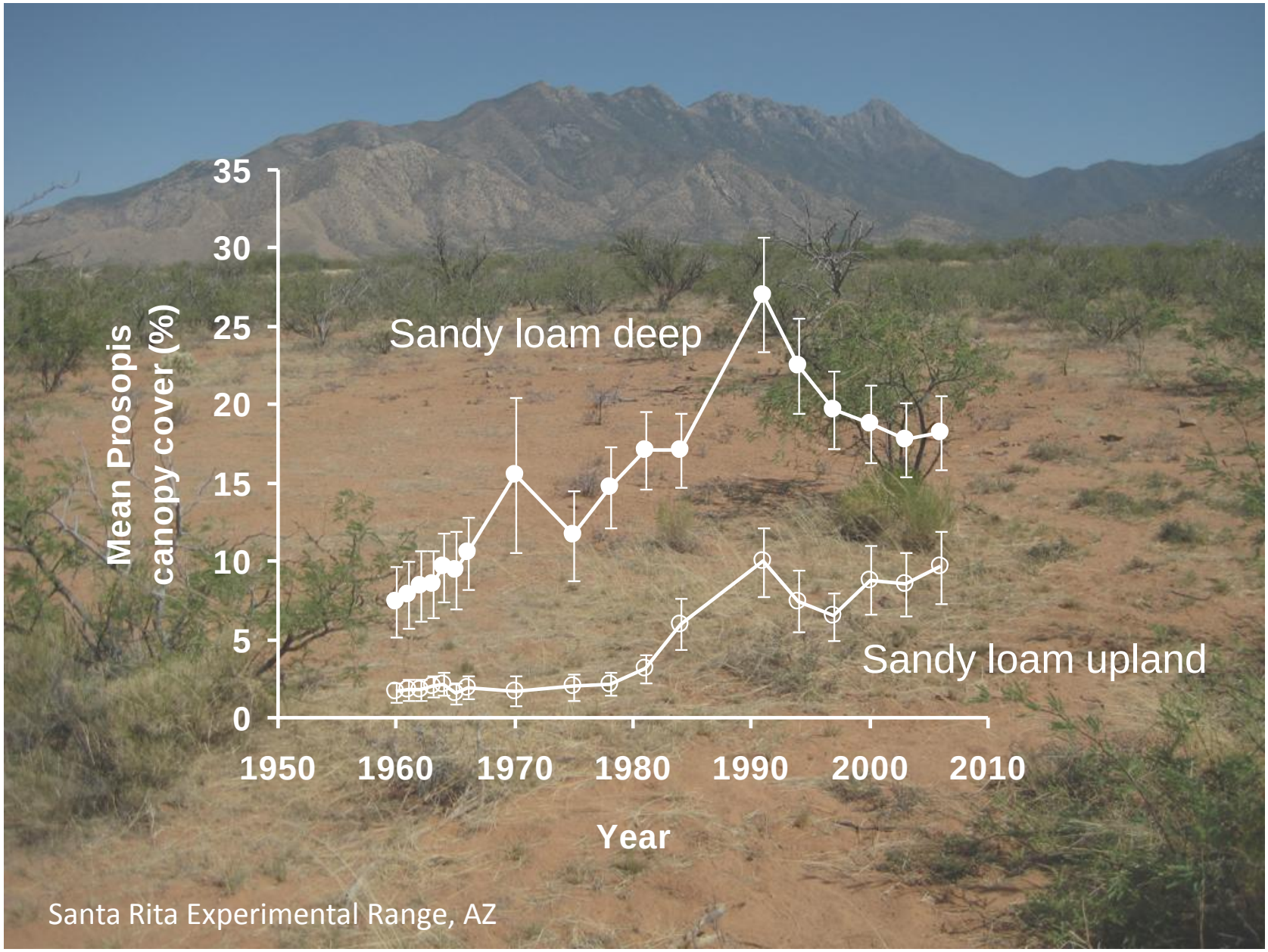


Major Land Resource Areas of the continental USA

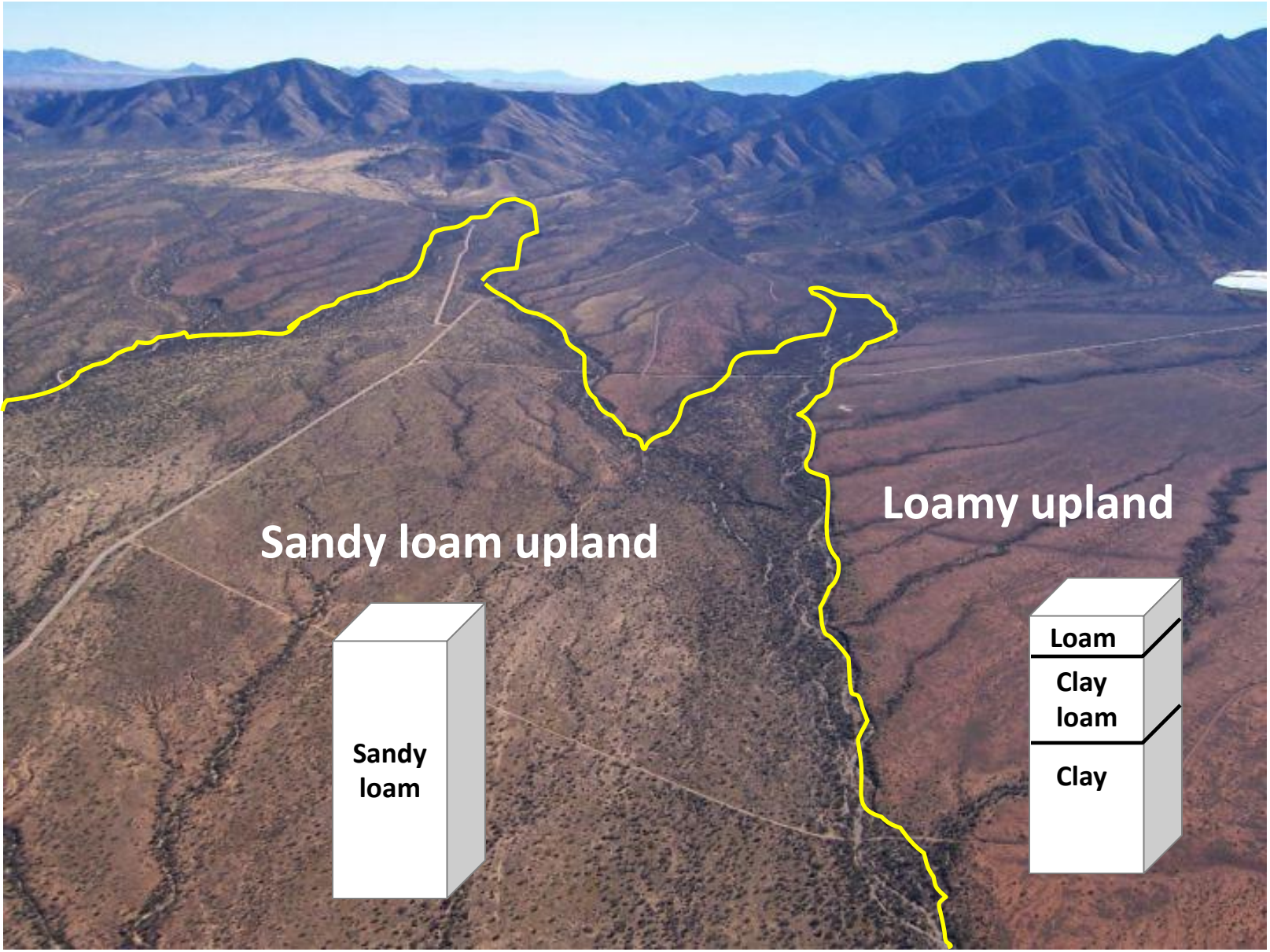
The MLRA-level "model" is filtered by soils/topography and local climate (LRU)



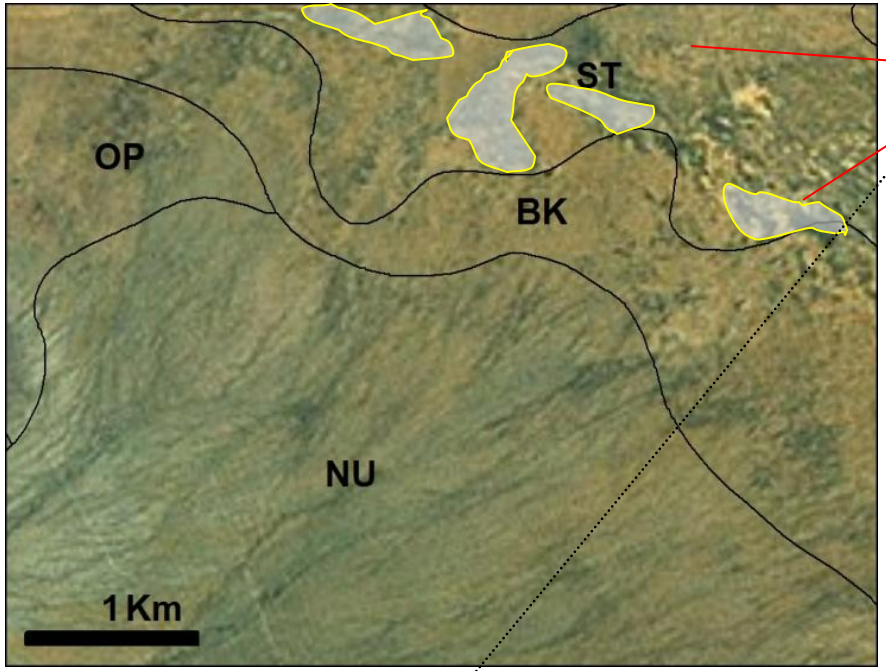
Subtle soil variations are important: the effects of differences in clay content



Ecological sites concepts developed based on relationship of soil profiles to soil processes and vegetation pattern



Ecological sites classify soil map unit components (soil series phases) of the US National Cooperative Soil Survey

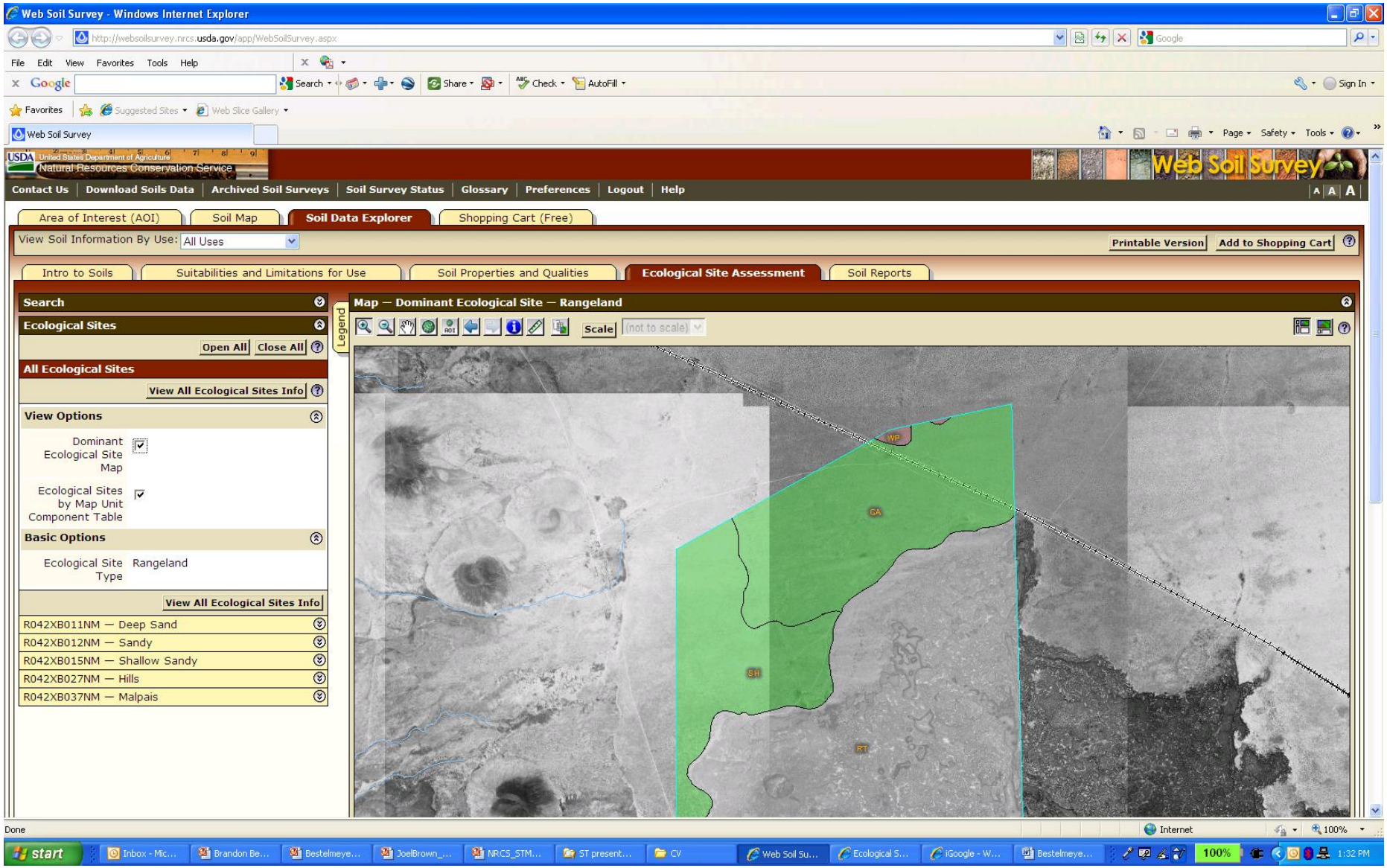


Map unit/components	*Ecological site*
ST: Stellar association	
40% Stellar clay loam, 0-3% slopes	= *Clayey*
40% Stellar clay loam, 0-3% slopes, flooded	= *Bottomland*
20% other inclusions	
BK: Berino-Dona Ana association	
50% Berino fine sandy loam, 1-5 % slopes	= *Sandy*
30% Dona Ana fine sandy loam,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

A soil map unit can contain more than one ecological site

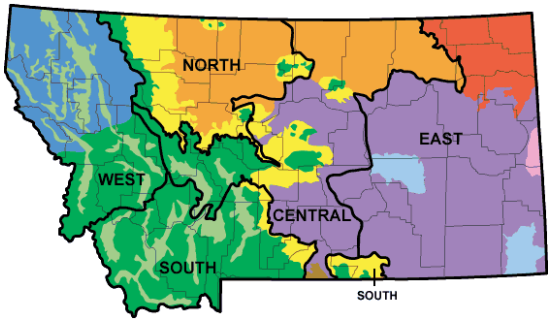
An ecological site groups several similar soil map unit components

Soil information and geographic databases allow for digital maps of dominant ecological sites across most of United States



Ecological site keys allow for local identification within map units

MONTANA RANGELAND ECOLOGICAL SITE KEY (part)



7b. Soils Moderately Deep, Deep, or Very Deep (>= 20” deep)
17a. Soil Skeletal
- **18a. Soil Sandy-Skeletal**
  - **19a. Sandy-skeletal within 0-10” of soil surface - Gravelly (Gr)**
  - **19b. Sandy-skeletal within 10-20” of soil surface & consists of gravels and/or cobbles**
    - **20a. Strongly or violently effervescent within top 4” – Shallow to Gravel, Limy (SwGrLy)**
    - **20b. Not Strongly or violently effervescent within top 4”– Shallow to Gravel (SwGr)**
- **18b. Soil Loamy-Skeletal**
  - **21a. Strongly or violently effervescent within top 4” – Limy Droughty (LyDr)**
  - **21b. Not Strongly or violently effervescent within top 4”**
    - **22a. Slope <15%**
      - **23a. Soil surface texture is very fine sandy loam, loam, silt loam, silty clay loam or clay loam – Loamy Droughty (LoDr)**
      - **23b. Soil surface texture is coarse sandy loam to fine sandy loam – Sandy Droughty (SyDr)**
    - **22b. Slope >=15%**
      - **24a. Soil surface texture is very fine sandy loam, loam, silt loam, silty clay loam or clay loam – Loamy Droughty Steep (LoDrStp)**
      - **24b. Soil surface texture is coarse sandy loam to fine sandy loam – Sandy Droughty Steep (SyDrStp)**

The state-and-transition model

Diagrams, text descriptions, and associated data that describe possible changes in vegetation and soils within particular ecological sites

1) *Each representative of an ecological site can exist as one or more states or community phases*

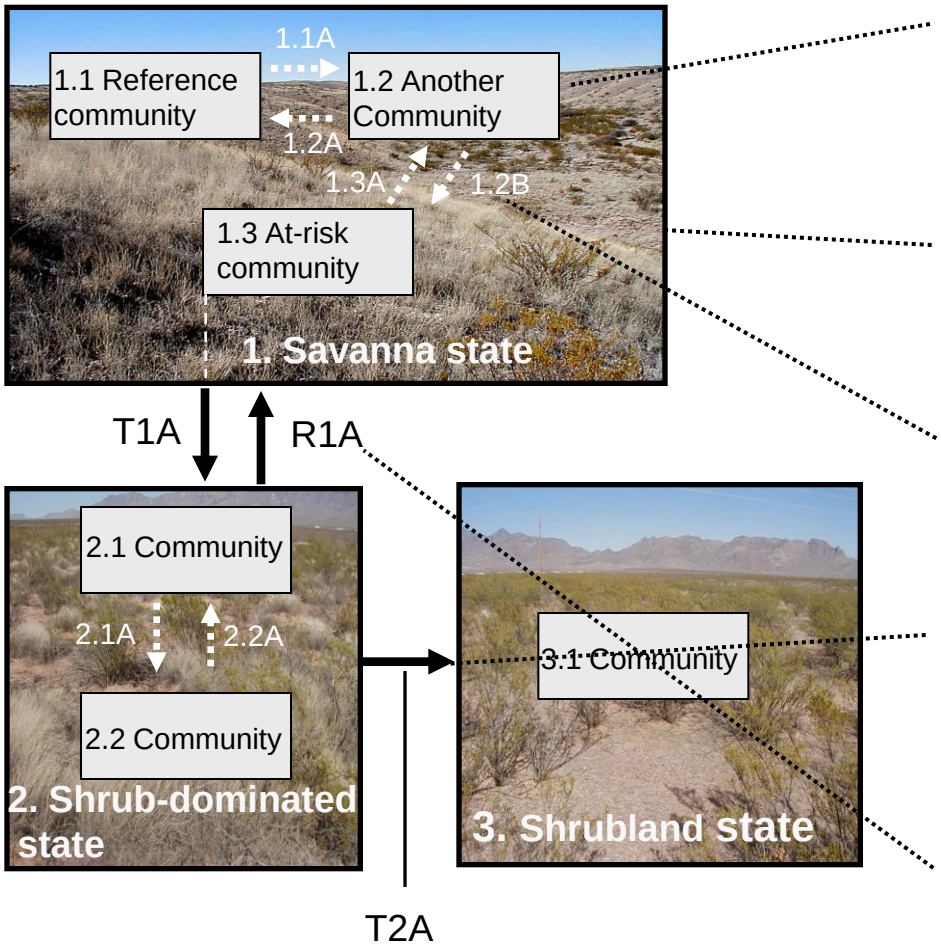
2) *State and transition models are repositories of synthesized science information and local knowledge*

3) *Guide development of management hypotheses and interpretation of assessment and monitoring data*

4) *Their focus should be on ecological processes underpinning responses to management and natural drivers*

5) *Monitoring is used to update models*

State-and-transition models now feature standardized approaches for the production of narratives (not yet fully adopted)



Community phase
Bush muhly-creosotebush community

State
Savanna state

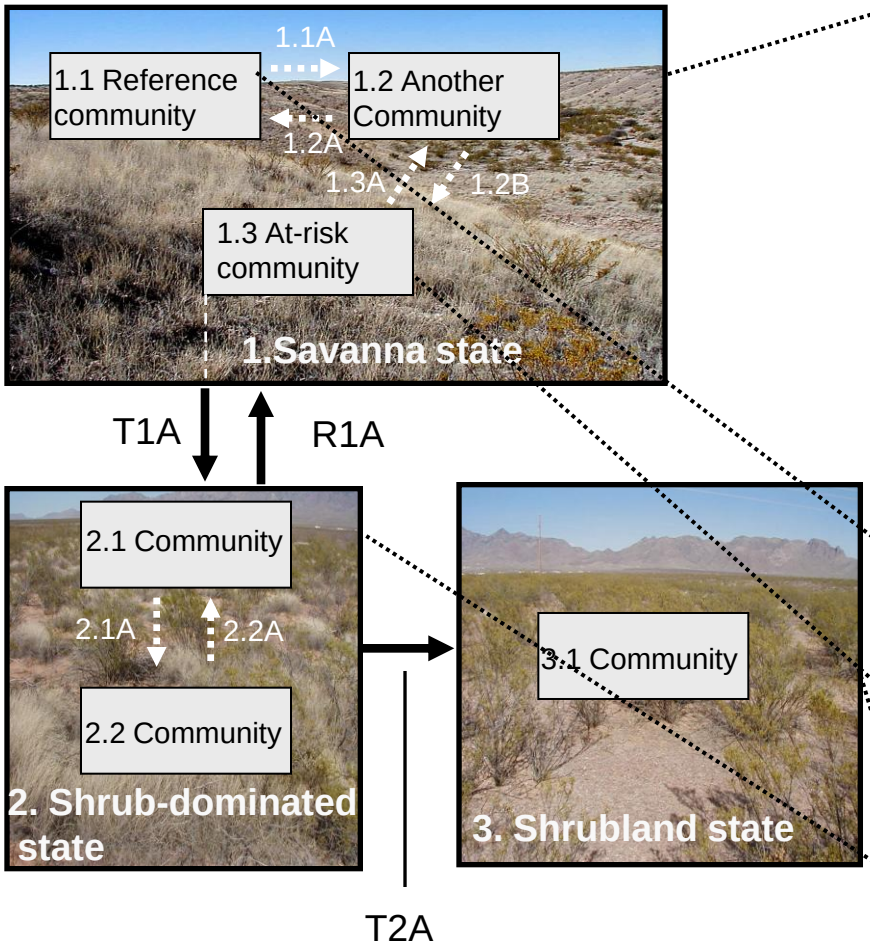
Community pathway
Winter-spring rainfall exceeds 100 mm

Transition
Loss of perennial grasses and soil erosion that favors woody plant dominance and alters productivity

Restoration pathway
Control of woody plants with clopyralid + triclopyr mixture followed by two growing season rest results in increased grass establishment

Narratives for states and communities contain indicator values and management strategies to promote resilience

Specific components of state descriptions



Reference state
Black grama-creosotebush savanna (historical + extant)

Indicators/Diagnosis
Bouteloua eriopoda >15% foliar cover, *Larrea tridentata* <12% foliar cover, little erosion

Ecological Feedbacks
Perennial grass continuity promotes soil and water retention and fire

Management
Summer grazing rest in drought, fire every 20 years

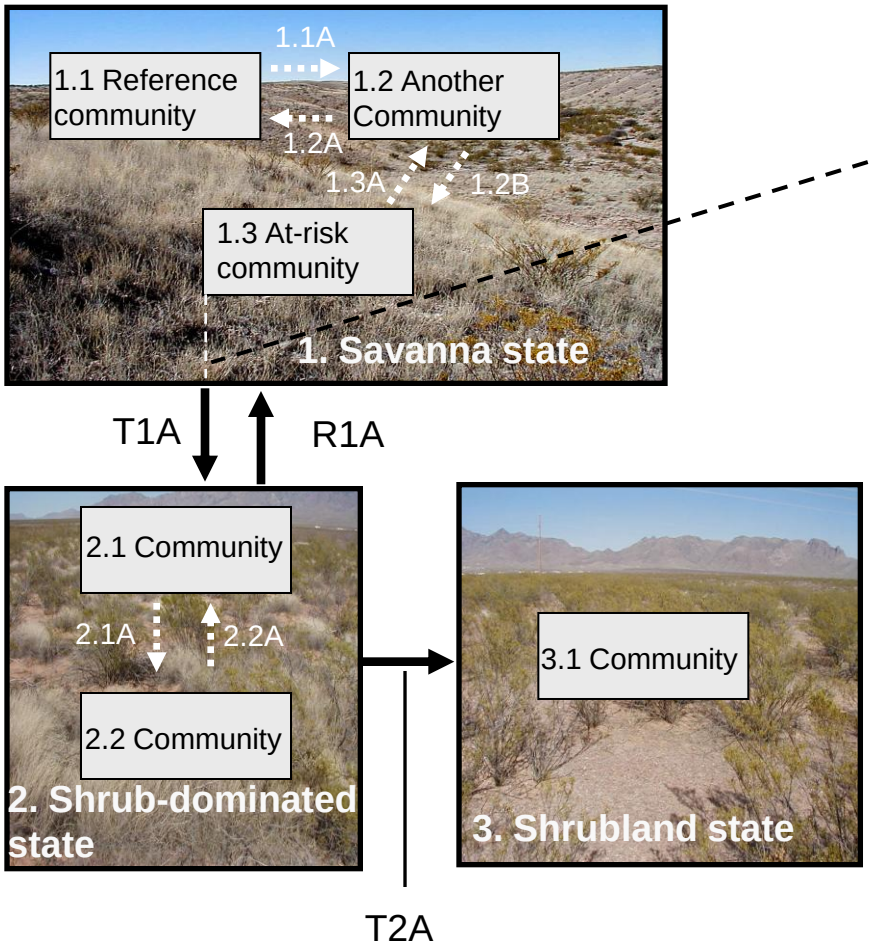
Reference community phase
Bouteloua eriopoda (15-60% foliar cover), *Larrea tridentata* (1-5% foliar cover)

At-risk community phase
Bouteloua eriopoda (3-5% foliar cover), large bare patches

Alternative states
Shrub-dominated, shrubland states

Narratives for transitions highlight the sequences of management conditions and events that lead to ecological thresholds

Specific components of transition descriptions



Transition (T)

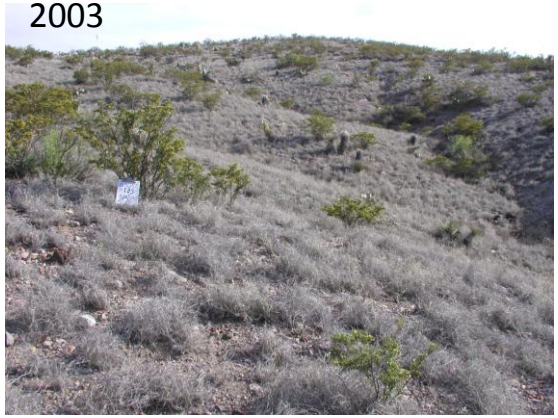
Slow variables and triggers
Chronic heavy defoliation coupled to multi-year drought events

Threshold
Black grama grass cover loss to < 3% and inability to recover continuity via vegetative growth

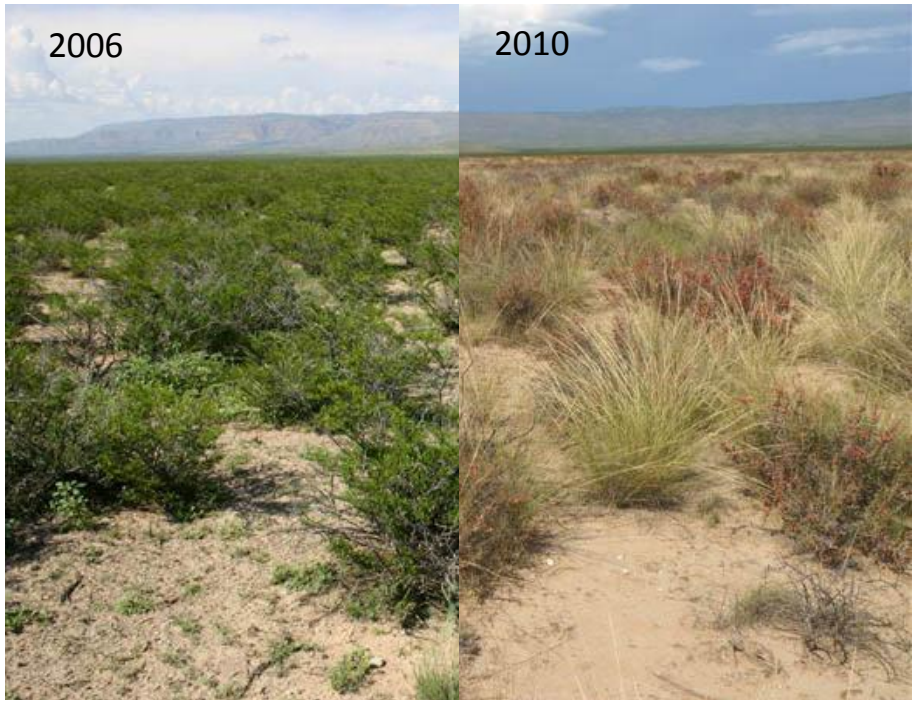
Ecological sites and state-and-transition models are developed through collaboration and include local knowledge

Photo courtesy of Emily Kachergis

Monitoring, management experiments, and historical reconstructions are used to develop transition and restoration narratives

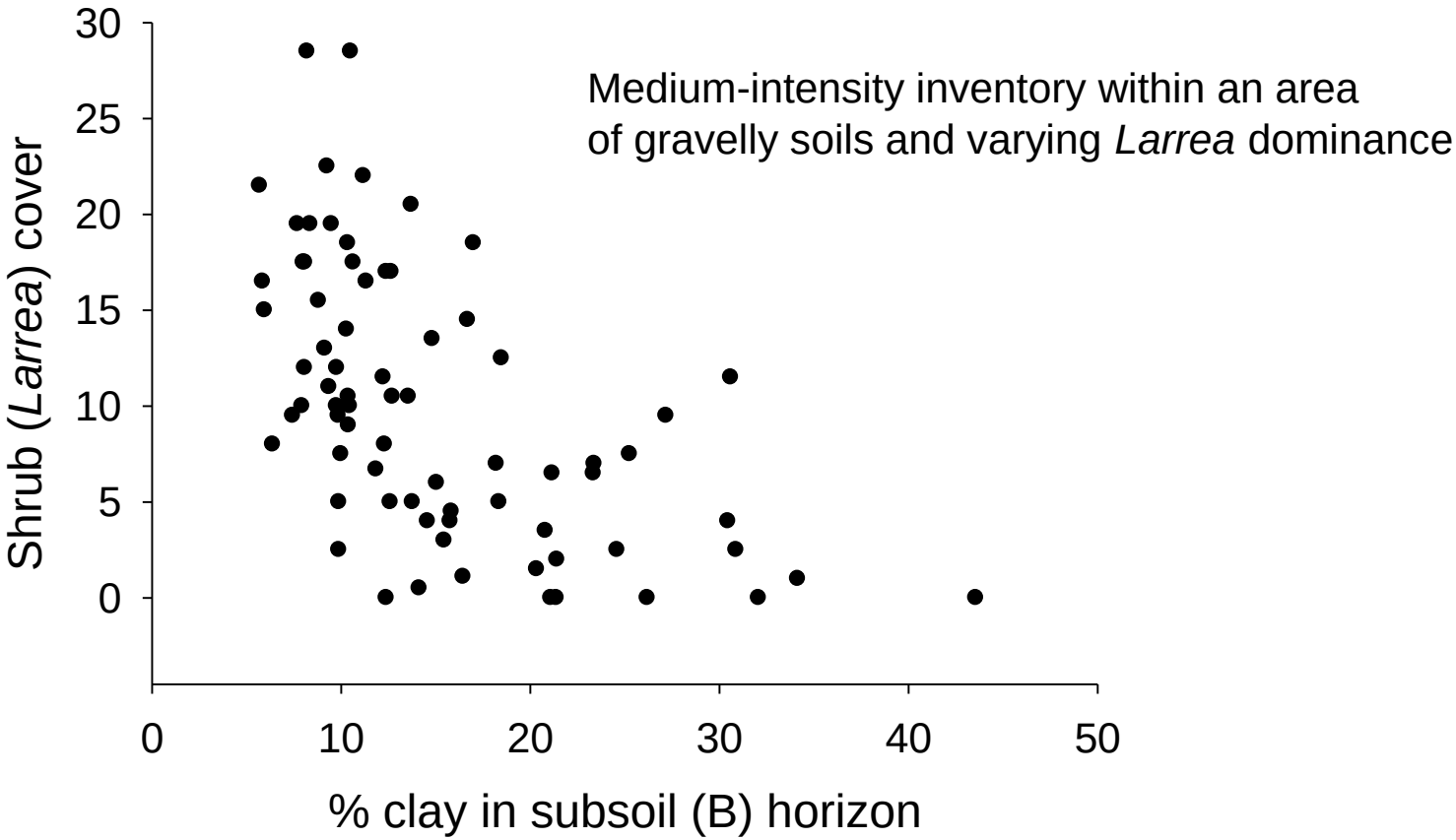


Altered grazing management

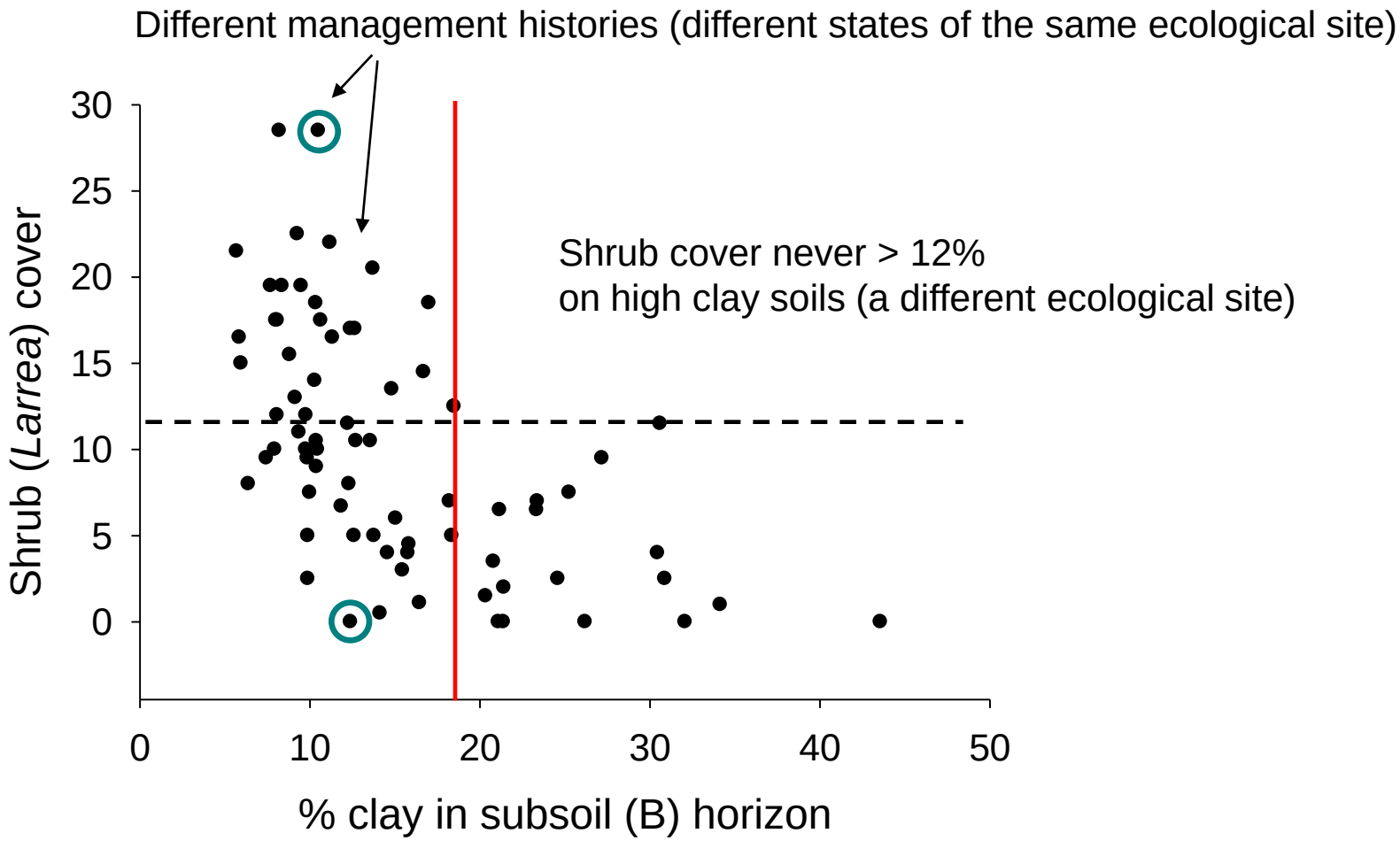


Shrub-specific herbicide

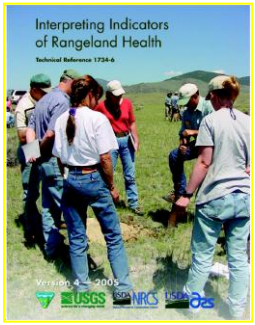
Ecological sites and state-and-transition models also rely heavily on inventory

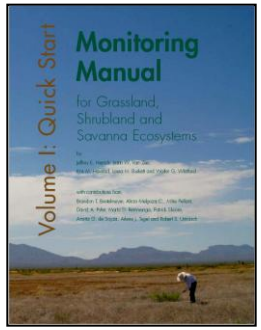


Ecological sites and state-and-transition models also rely heavily on inventory



Standardized measurement and indicator protocols associated with development and testing of models





E.g., change in the basal cover of plants

State-and-transition models can be used to create management hypotheses

	Indicators	*Specific management protocols*
 **Shrub savanna state**	Grass cover is > 15% only small bare patches	Keep on doing what you're doing, fire management if possible
 **Shrub-dominated state**	Shrub cover >12%, few grass patches, interconnected bare areas	Summer grazing rest, shrub control to increase grasses
 **Shrubland state**	Shrub cover >12%, absence of perennial grasses, eroded soil	Long-term rest to take, advantage of very rainy years, shrub control avoided

The ecological site description report has four parts

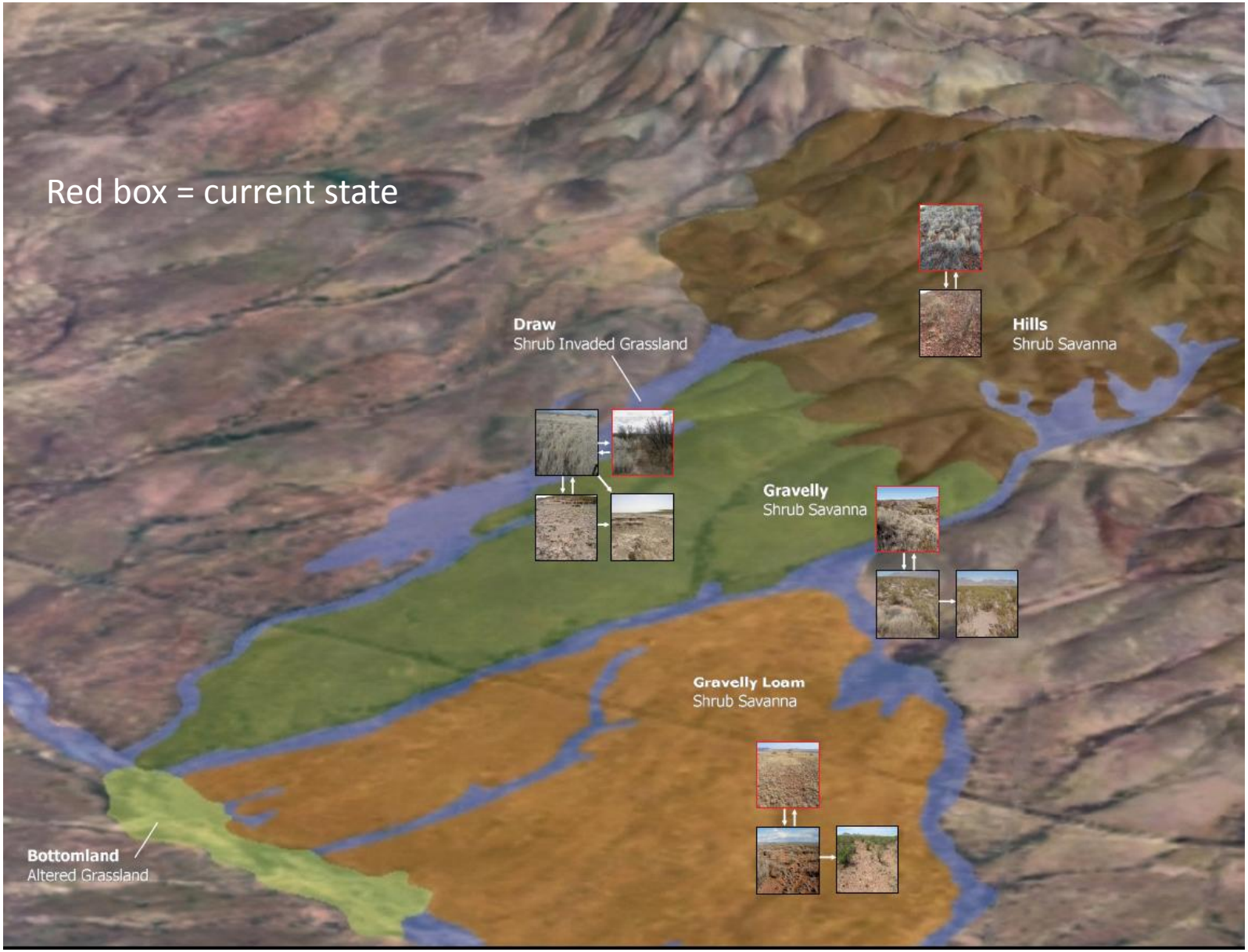
Physical Characteristics -- Distinguishing physiographic, climate, soil, and hydrological features of the ecological site class, including variability within the class

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

Maps of ecological sites and states specify where different interventions are needed in a landscape to attain particular services/values



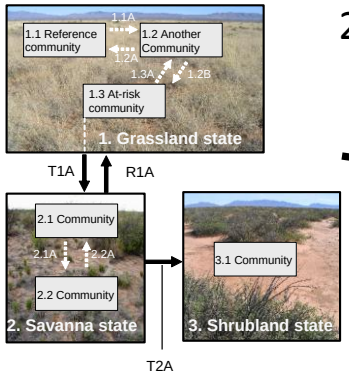
Landscape-level model-based restoration projects

1. Collaboration

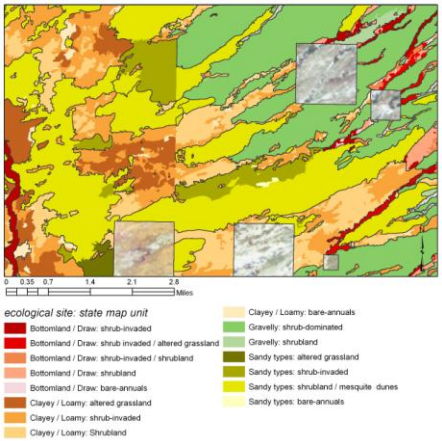
What are the risks
and known problems?

Where are they located?

At what scales must solutions
be sought?



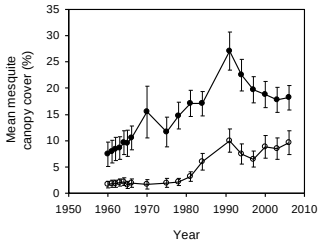
2. Ecological sites/state-and-transition models,
indicators, and management practices



3. Maps of ecological sites and states

4. Apply intervention or do nothing

5. Monitoring to
test models
(did we cross a threshold or
restore the desired species?)



6. Database results
and modify models,
collaborative learning

National-level updating and storage of information