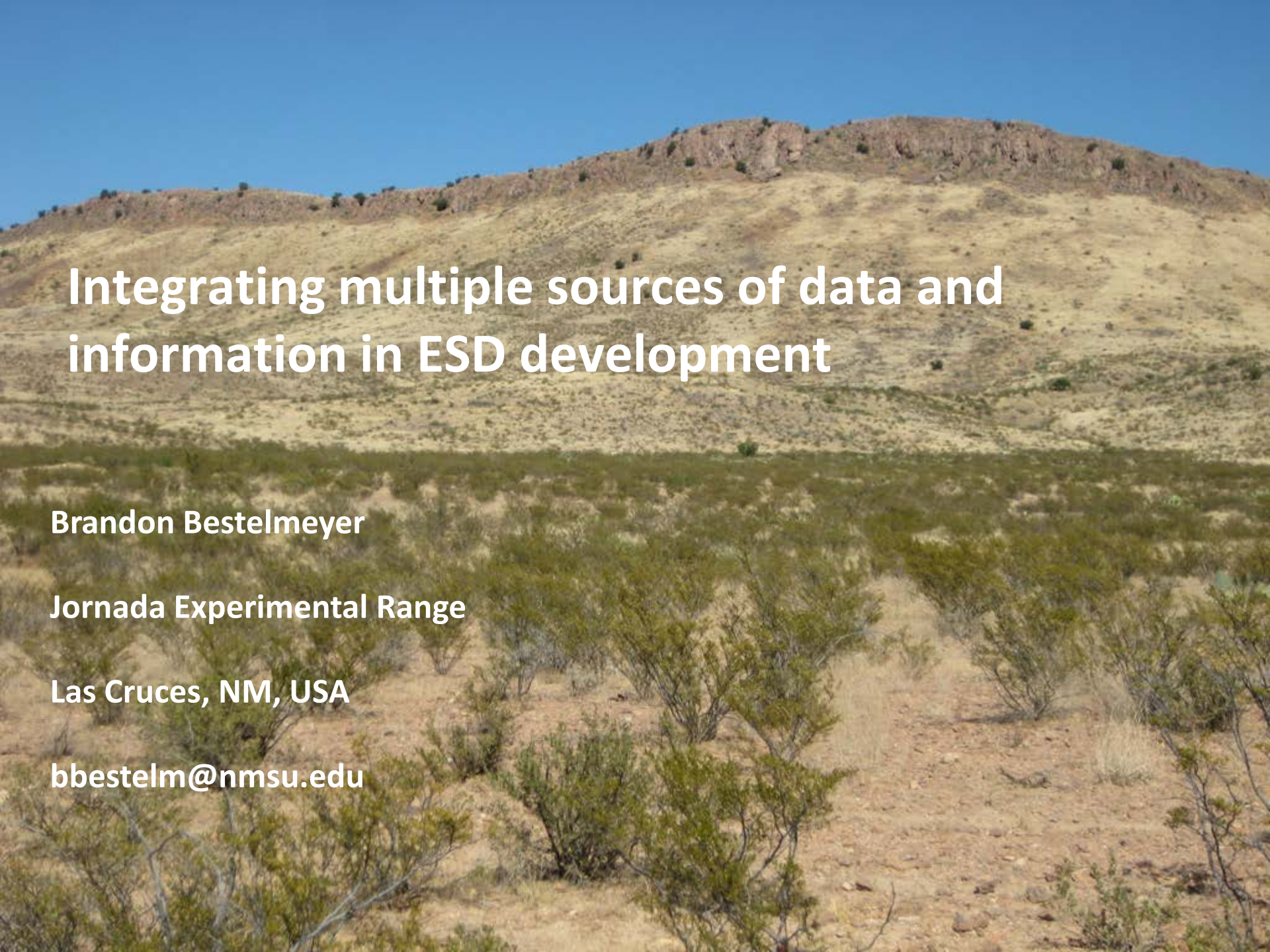

Integrating multiple sources of data and information in ESD development

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What do we need data and information for?

1. ***Develop ecological site/STM concepts for a region***

2. ***Test and formalize site concepts and keys***

3. ***Develop detailed state-and-transition models***

4. ***Describe properties, services, and interpretations for plant communities/states within ecological sites***

There is no exact recipe, but the common ingredients follow…

1. Develop ecological concepts and initial STMs

Preliminary concepts

- Literature
- GIS data
- Existing inventory data
- Workshop, collective knowledge
- Rapid field survey/traverse

→

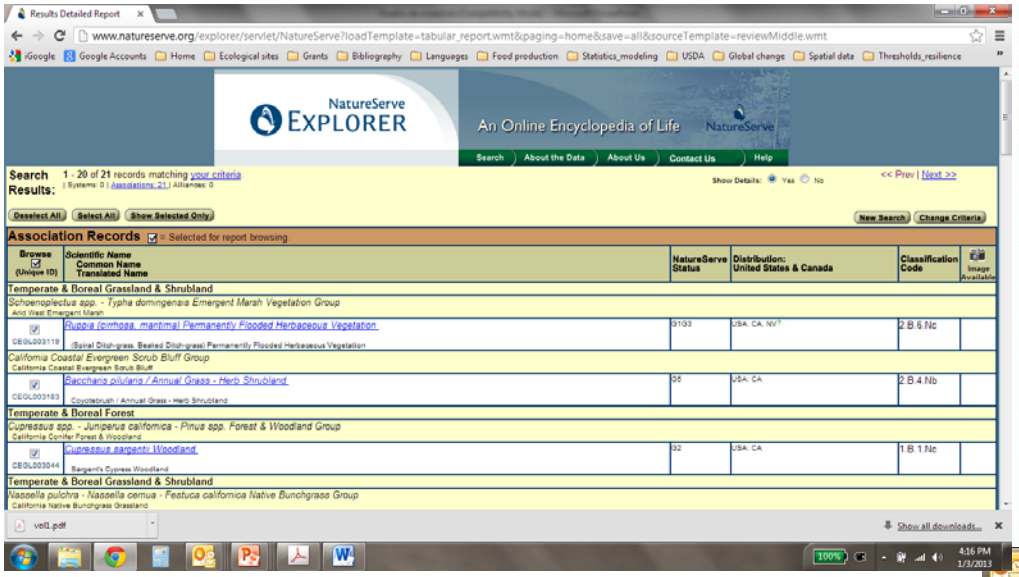
-Concepts for ecological sites and states
-Areas for more intensive sampling

Literature/maps: stand on the shoulders of giants…

-existing plant community classifications, key species (http://www.natureserve.org/explorer/servlet/NatureServe?init=Ecol)

-papers on plant-soil/plant-climate relationships

-find papers using Journal Map: www.journalmap.org

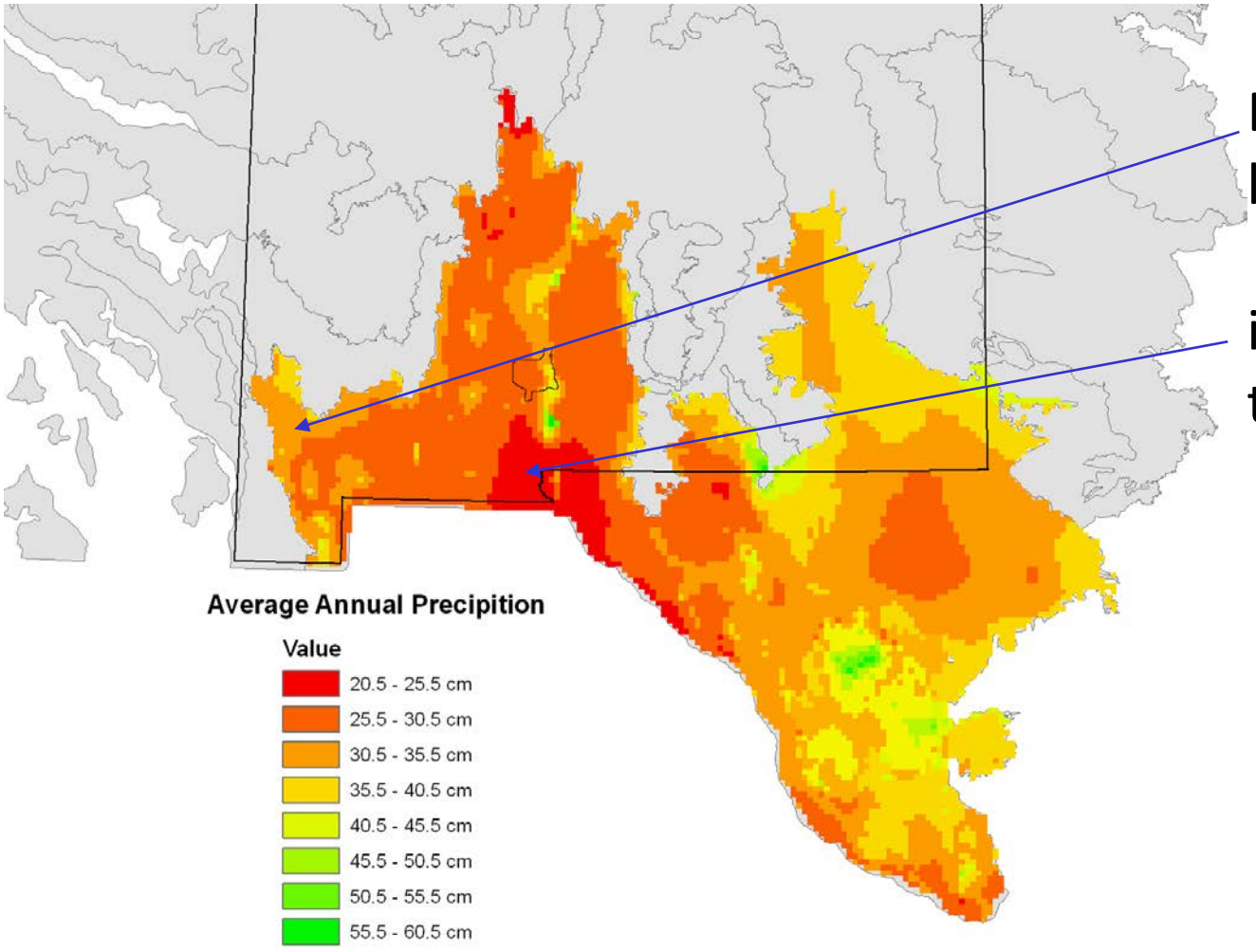


Literature: general knowledge of plant-soil relationships

Type	*Variable (units)*
Hydrology	
	Water table depth *(m)*
	Flooding duration *(days)*
Soil physical properties	
	Soil texture of surface *(class or %)*
	Fragment content *(%)*
	Argillic horizon development *(class)*
	Soil depth to restrictive layer *(cm)*
Lithology/geology	
	Bedrock type *(class)*
Topography/landform	
	Landscape position *(class)*
Chemistry	
	Electrical conductivity *(mmhos)*
	Soil gypsum content/distribution in profile *(%/cm)*
	Soil carbonate content/distribution in profile *(%/cm)*

Tip: look at ecological site classifications from similar ecoregions!

GIS data layers: major gradients in vegetation, climate, geology, soils, within the study area to plan sampling



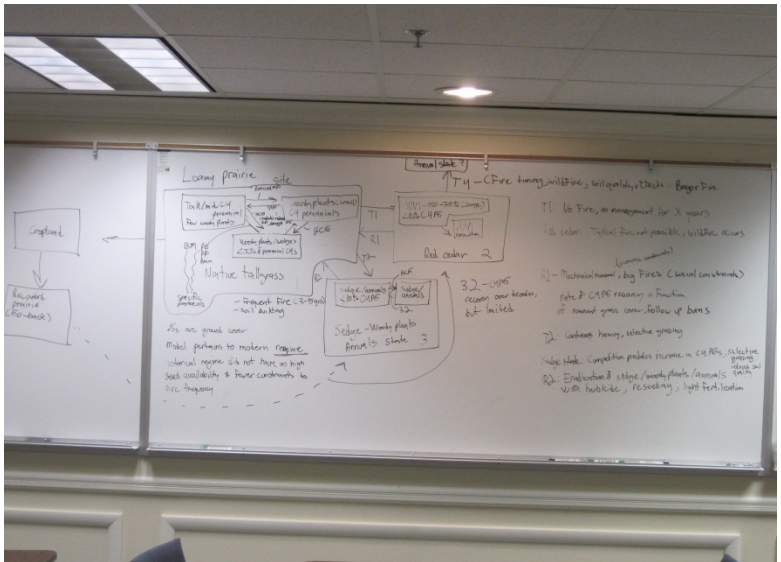
Ecological potential here…

is probably different than it is here

http://www.prism.oregonstate.edu/

<u>People who live there</u> may have a working classification that can be refined or know where important differences in vegetation are expressed

Build initial STMs since vegetation differences might be states rather than sites



Low intensity inventory/reconnaissance

Plant community composition/production

-rapid ocular estimates

Soil surface properties

-pedoderm and pattern classes, rangeland health indicators (http://jornada.nmsu.edu/node/2883)

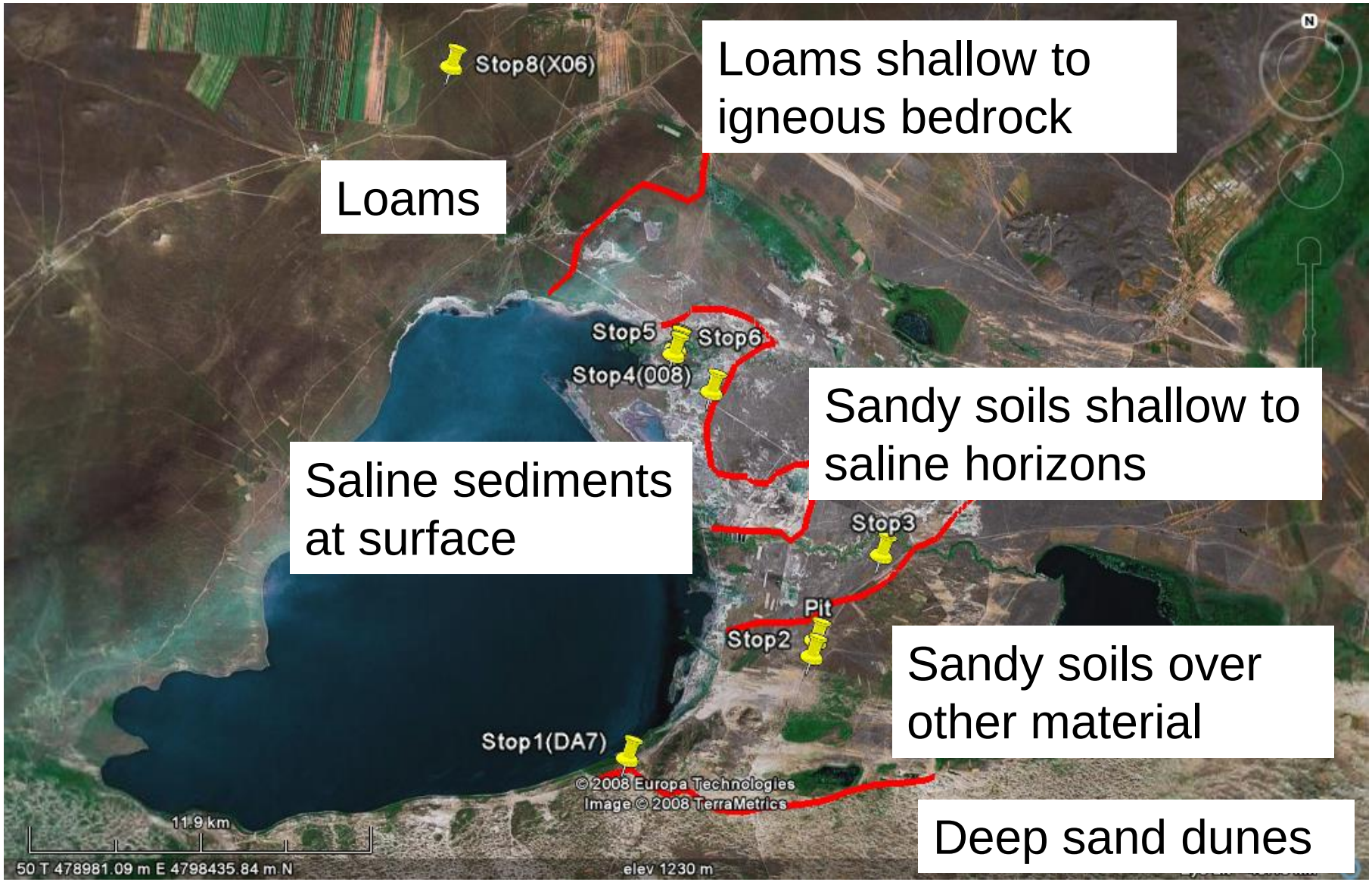
Soil profile properties

-soil auger or pit to find key soil properties

Landscape position

-slope, aspect, elevation, slope shape

A quick and dirty international example: Inner Mongolia, China


Stop8(X06)
Loams shallow to igneous bedrock
Loams
Stop5
Stop6
Stop4(008)
Sandy soils shallow to saline horizons
Saline sediments at surface
Stop3
Pit
Stop2
Sandy soils over other material
Stop1(DA7)
© 2008 Europa Technologies
Image © 2008 TerraMetrics
Deep sand dunes
11.9 km
50 T 478981.09 m E 4798435.84 m N
elev 1230 m

Ecological site concepts after reviewing the data

Name: Sand plains
Concept: > 50 cm of
Loamy sand or sand over similar soils or buried soils/bedrock

Indicator plants: *Caragana*

Transition processes: wind/water erosion, dune formation

Name: Saline sandy
Concept: < 50 cm of loamy sand or sand over saline soil

Indicator plants: *Acnatherum*

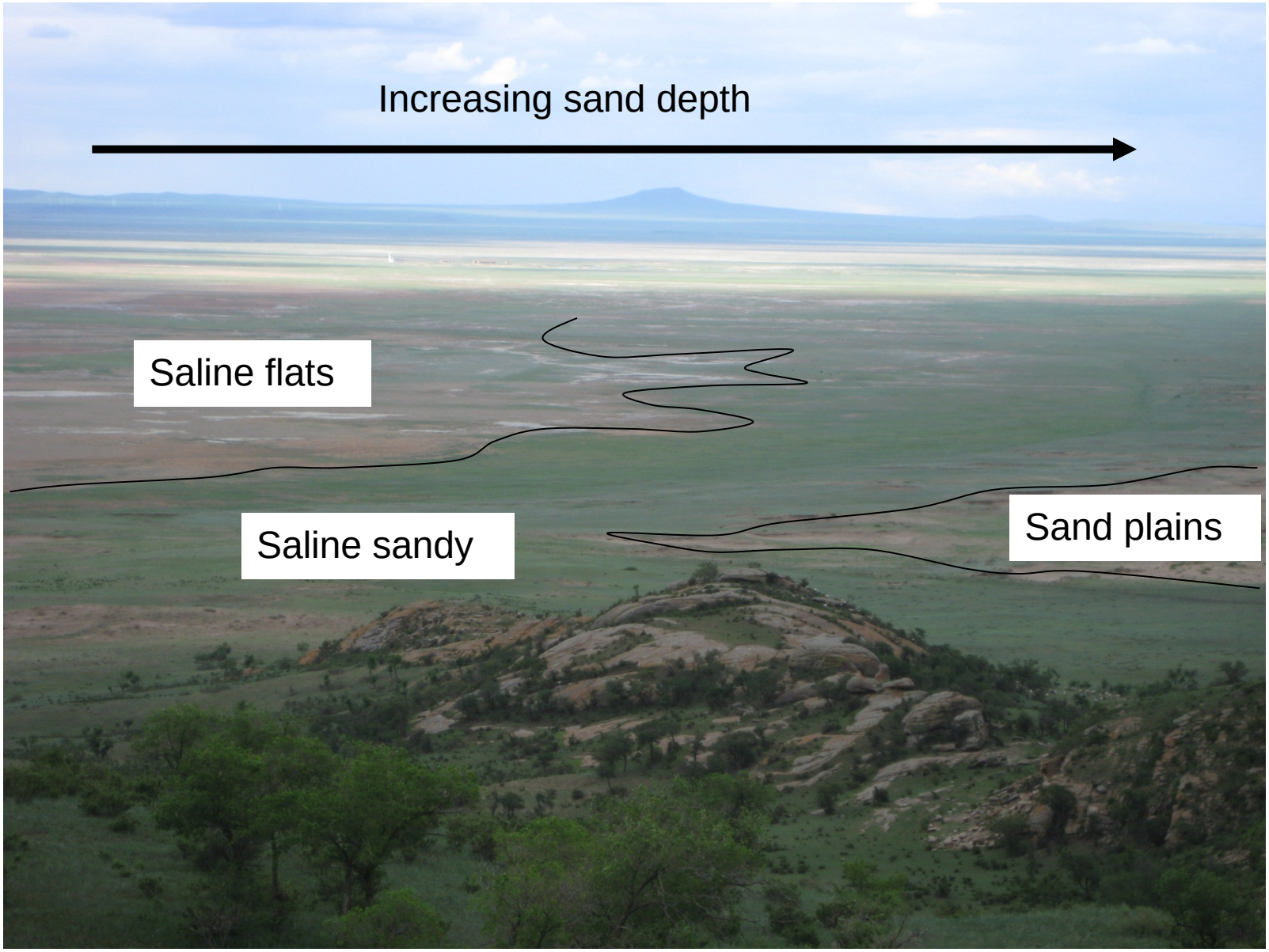
Transition processes: Erosion exposes saline soil

Name: Saline flats
Concept: Silt loam to loam over stratified silty clay loam and loamy fine sand

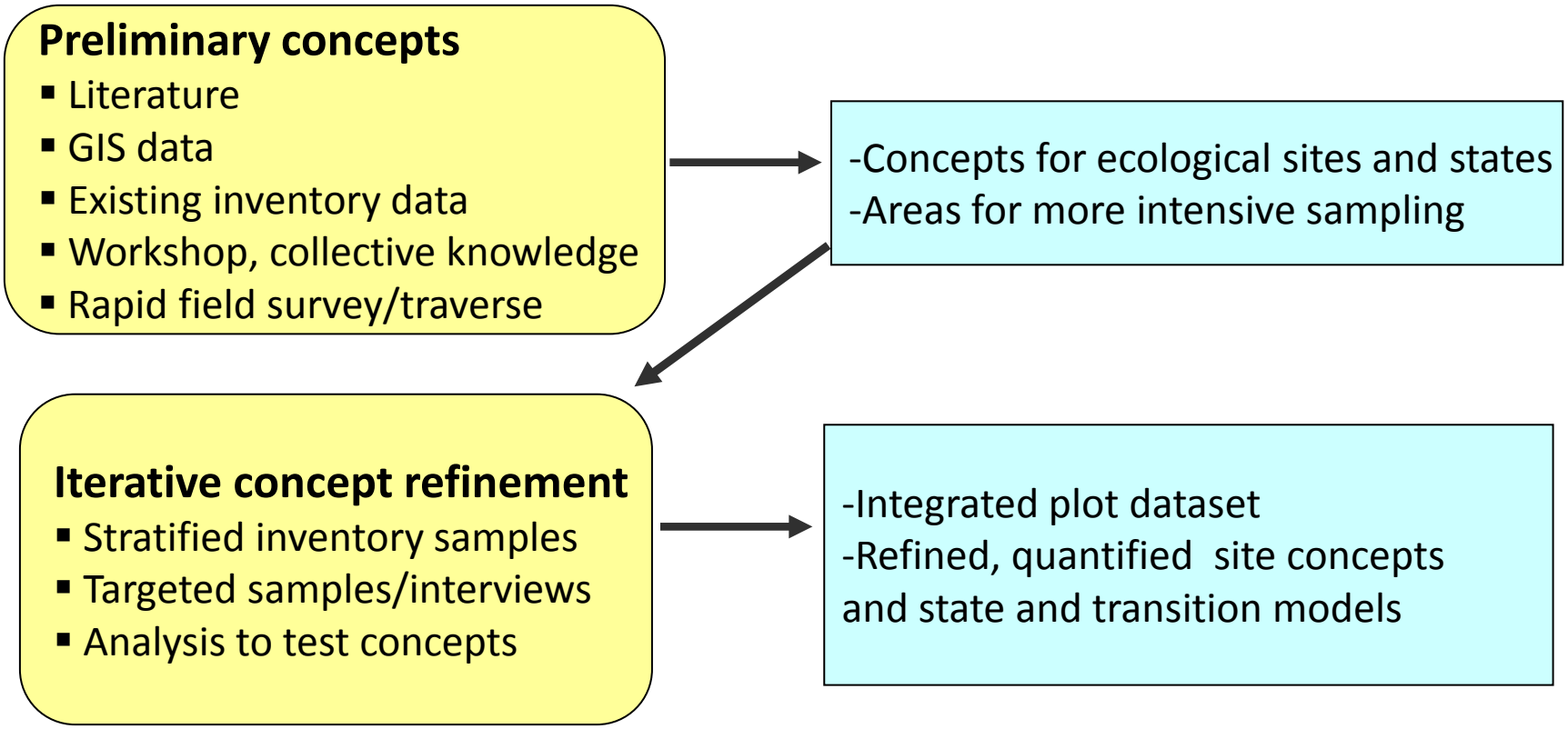
Indicator plants: *Nitraria*, *Sueda*

Transition processes: Erosion, changes to soil structure, infiltration, salinity

Ecological site gradient for concept refinement phase



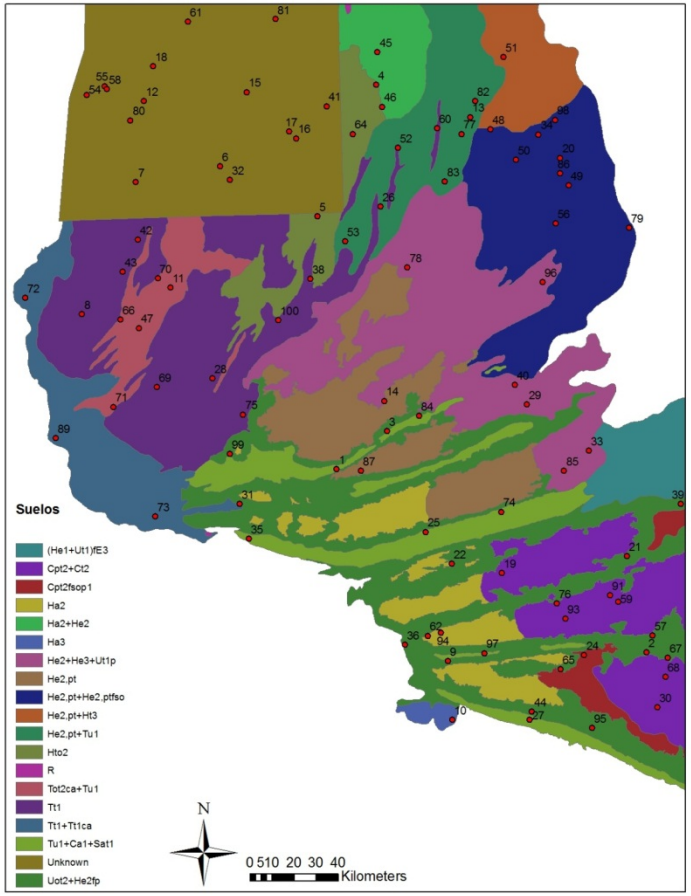
2. Test and formalize site concepts and keys



Systematic inventories of two types

Stratified random: repeated samples of different ecological site delineations, focus on range of variation and resolving boundaries

Targeted sampling: sites deliberately selected (e.g., reference states, degraded states, sites with known management histories)



Medium-intensity inventory

Plant community composition/structure/production

-ocular estimates, step point, line point, double sampling, tree density/dbh/drc/height, vertical structure

Soil surface properties

-pedoderm and pattern classes, others as needed

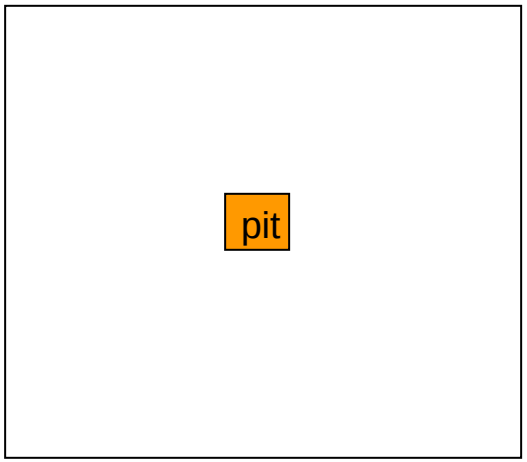
Soil profile properties

-soil minipit

Landscape position

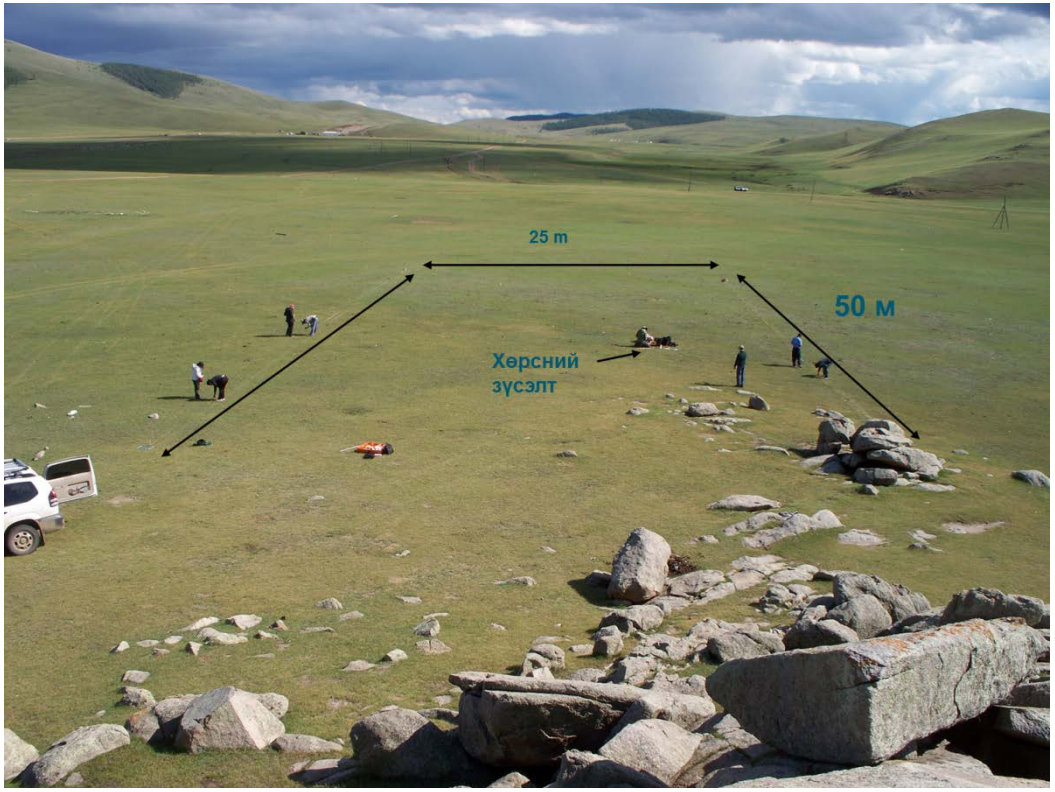
-slope, aspect, elevation, slope shape

Integrated plots



20 m

= 1/10th acre plot



Point-based approach: linked observations of vegetation and soils

-Testing ecological concepts and supporting soil-site correlation

-Quick enough to get needed replication

Steps in analysis of integrated plot data

1. Define specific concept problems to be solved

2. Output *relevant integrated plot data* based on initial ecological site concepts from database.

3 Delete records you know are not going to address the problem

4. Select the pertinent variables

5. Choose an adequate analysis approach

A set of uncomplicated ecological site boundaries

Slope, soil depth, vegetation all tightly correlated

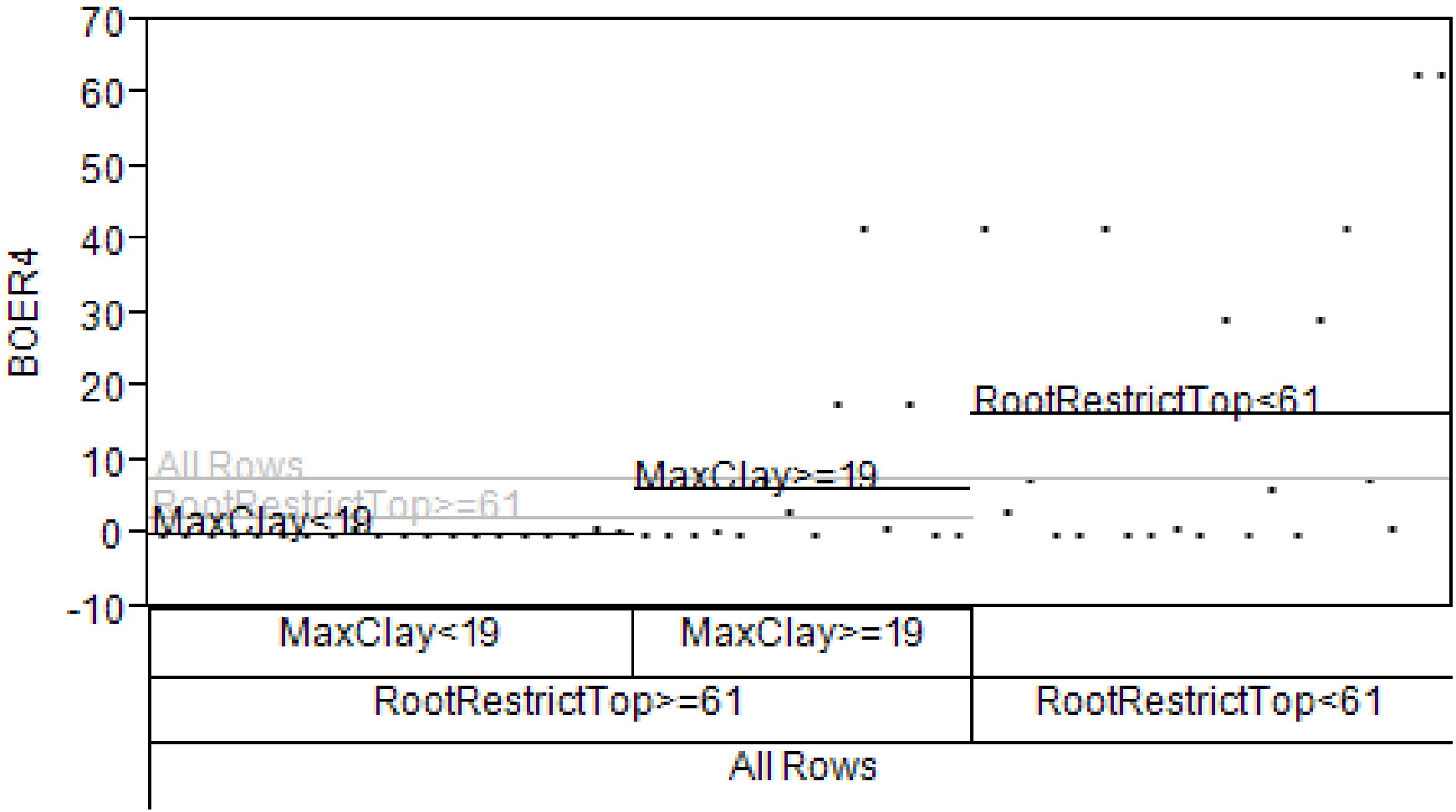
Question about unexplained variation within Sandy/Shallow Sandy

Increasingly sparse black grama within the same pasture, all Sandy ES

Hypothesis: Controlled by depth to caliche (Bkm) horizon or subsoil clay content

Subset only soils with non-gravelly loamy sand/sandy loam surface

A quick analysis—”Partition” procedure in SAS JMP



Perhaps need an extra ecological site (Sandy loam)
(recorrelation of some soil components to a new site)

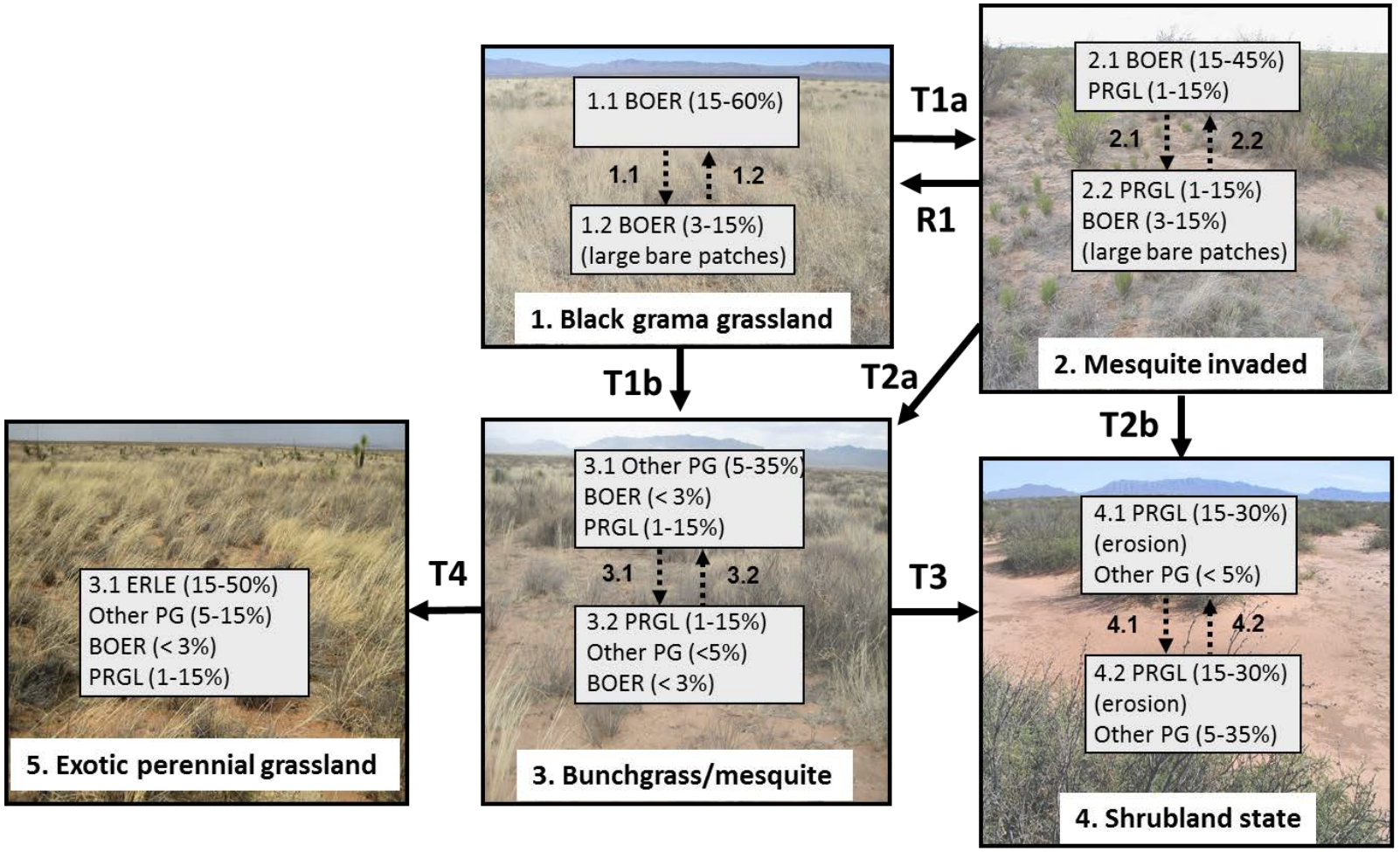
3. Develop detailed state-and-transition models

1. *What community phases are observed for the ecological site?* (inventory, historical accounts, local knowledge)

2. *What is the reference state/community phase?* (historical accounts, inventory in relict areas)

3 *What are the ecological states, transitions, thresholds, and restoration pathways*? (monitoring data, local knowledge, inventory across fencelines, experiments)

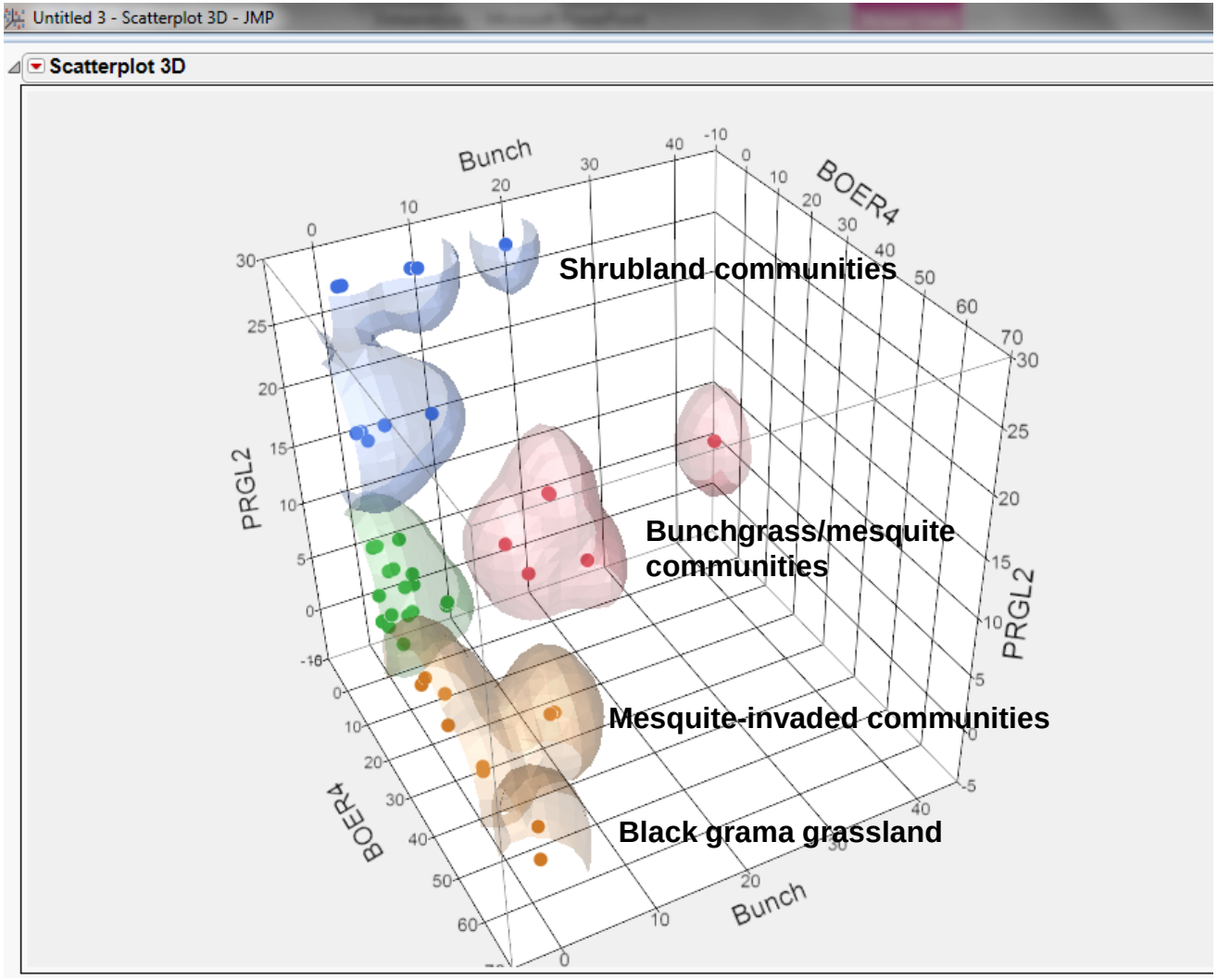
State and transition model for Sandy ecological site



T1a. Mesquite establishment facilitated by seed transport by cattle, bare patches > 50 cm, and relatively wet springs
R1. Shrub removal via herbicide or fire followed by black grama recovery to > 15%
T1b, T2a. Black grama is reduced below ca. 3% cover by heavy grazing in drought
T2b, T3. At perennial grass cover < 5%, wind and storm events, trigger deep, spreading soil erosion
T4. Invasion by Lehmann's lovegrass, dominance increased by fire

Evidence for 9 community phases and 4 states in inventory

(plus an additional example of an exotic-dominated community)



Evidence for the reference community phase and state

1. **General land office data (1858) from sandy soils**

2. **Historical photographs**

3. **Inventory from relict grasslands on the Jornada (maximum black grama foliar cover observed from 45-60%)**

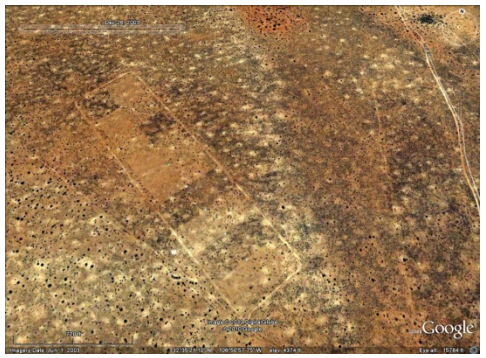
Including presence of poorly developed biological crusts, which are seldom observed

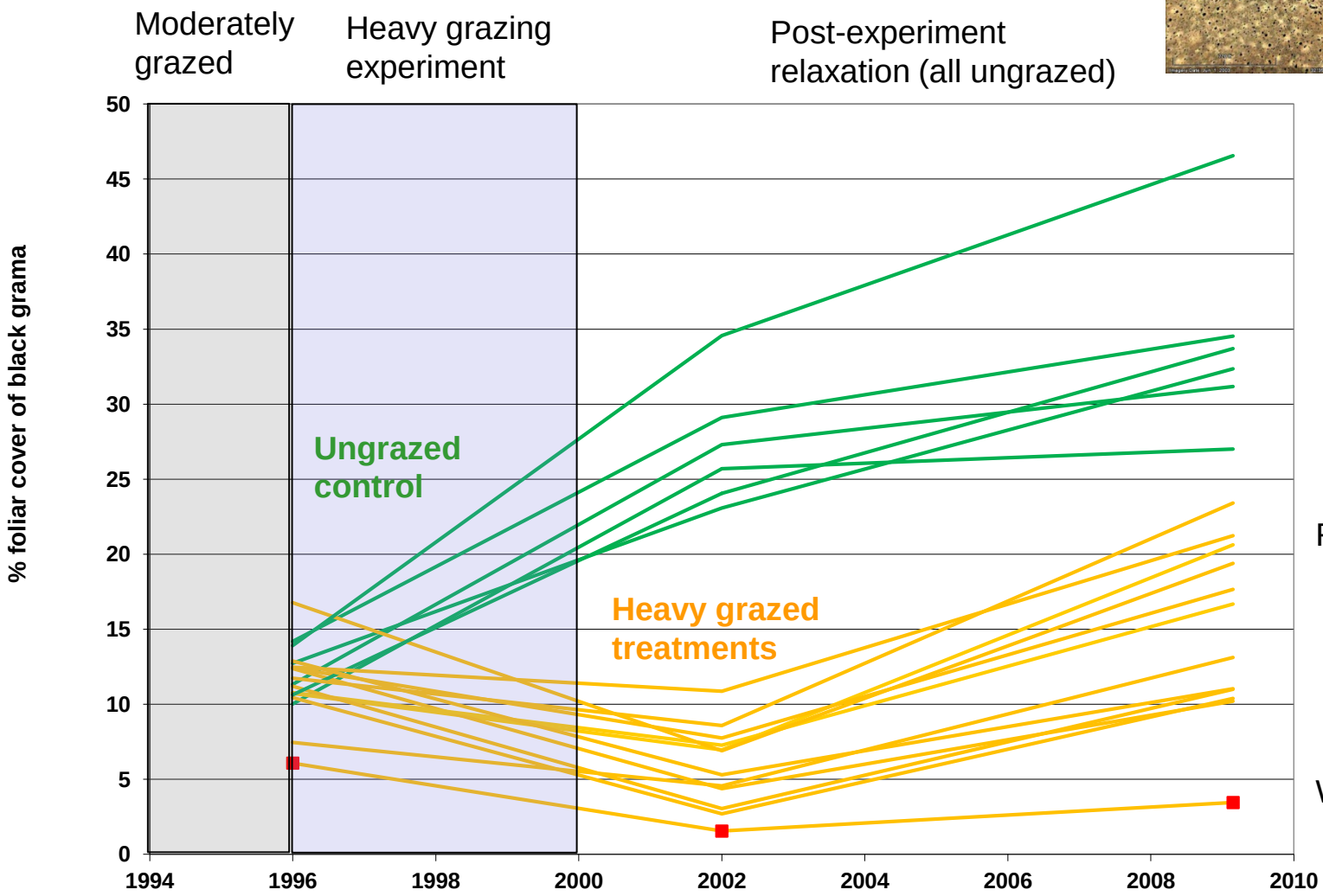
Evidence for transitions and restoration pathways

1. **Literature, historical accounts and photographs**
2. **Experiences from brush control efforts**

The effects of heavy defoliation on the soil surface evident in pre-transition photos

Experiment to estimate quantities for thresholds





Resilience evident

Weak recovery evident

Paddock with weak recovery -> threshold at ~3% foliar cover of black grama

4. Properties of community phases and states for ecological sites

Preparation and low intensity
- Define geographic extents
- Literature
- GIS data, other data
- Workshop, collective knowledge
- Rapid field survey/traverse

→ -Sampling strata and maps
-Concepts for ecological sites and states

Iterative concept refinement
- Stratified inventory samples
- Targeted samples/interviews
- Analysis to test concepts

→ -Integrated plot dataset
-Refined, quantified site concepts and state and transition models

Finalizing ESDs
- High intensity samples
- Management interpretations
- Soil-site correlation

→ -Benchmark data, esp. for reference
-correlations in NASIS
-ESD documents

Data to support management interpretations

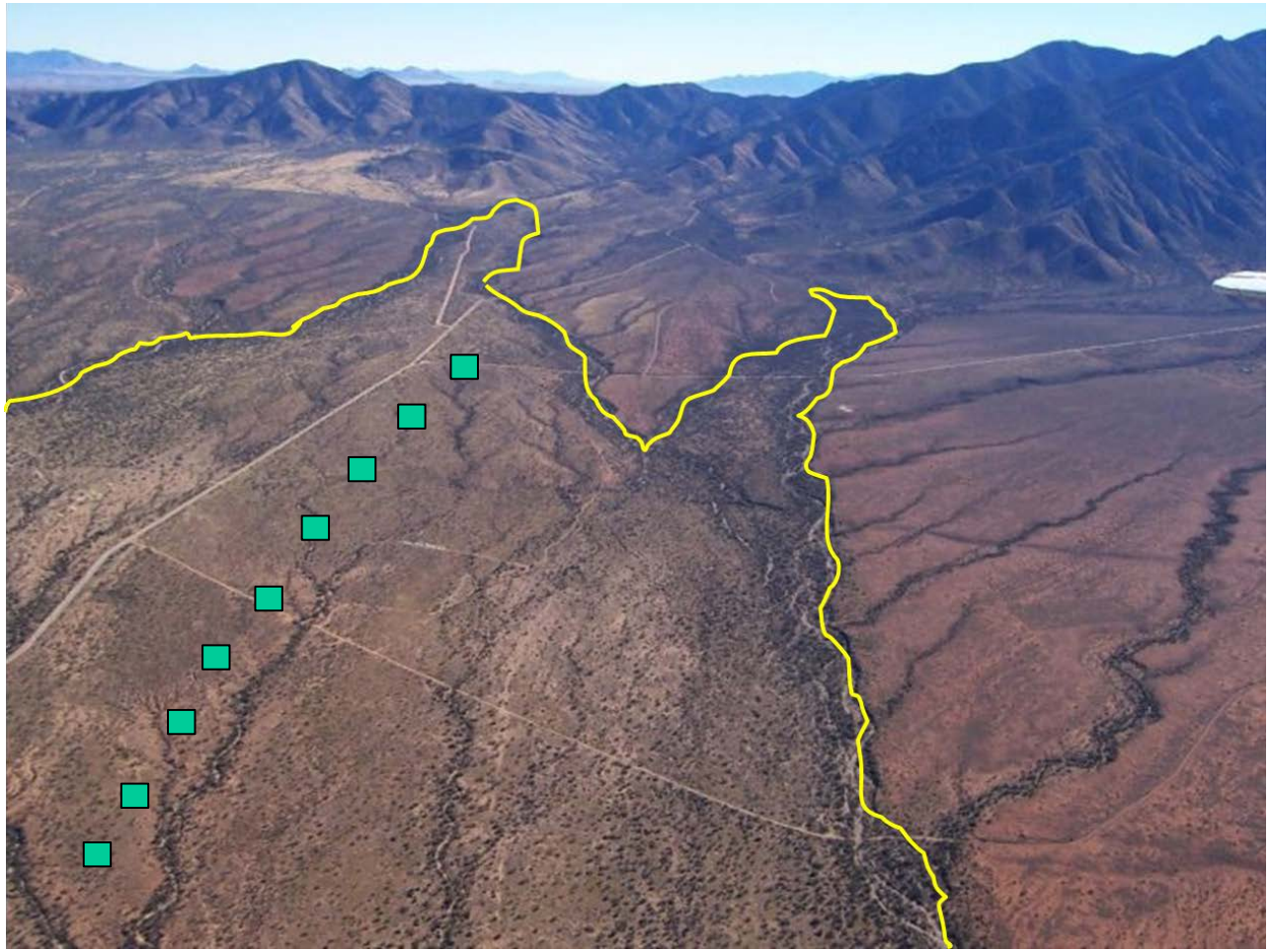
- High intensity data and other data:
  - Reference data on vegetation and DSPs
  - Domestic animal uses/forage
  - Wildlife habitat (by state or community)
    (see Holmes and Miller, JWM, 2010)
  - Hydrologic functions
  - Recreation
  - Future options (carbon sequestration, dust control, more detail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

High intensity sampling

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

- Soil Change Guide recommended plot design
- “a minimum number of characterizations should be agreed upon in the local work plan” (IESHR)
- Consider monitoring to document temporal variations due to climate

High intensity sampling



- Some interpretations need data at the scale of “ecological site units” or soil components (forage availability, habitat characteristics)
- Interpretations at level of landscapes?

Concluding remarks

- **ESD development is like good journalism: many sources of information and corroboration are needed**

- **ESD development should be driven by questions; the questions determine what information is useful. Make a list.**

- **Multidisciplinary collaboration and local knowledge are essential; a short conversation can provide focus or completely change your ESD**

- **Experiments on restoration or transition mechanisms can be powerful tools and can produce results that apply to several ESDs**