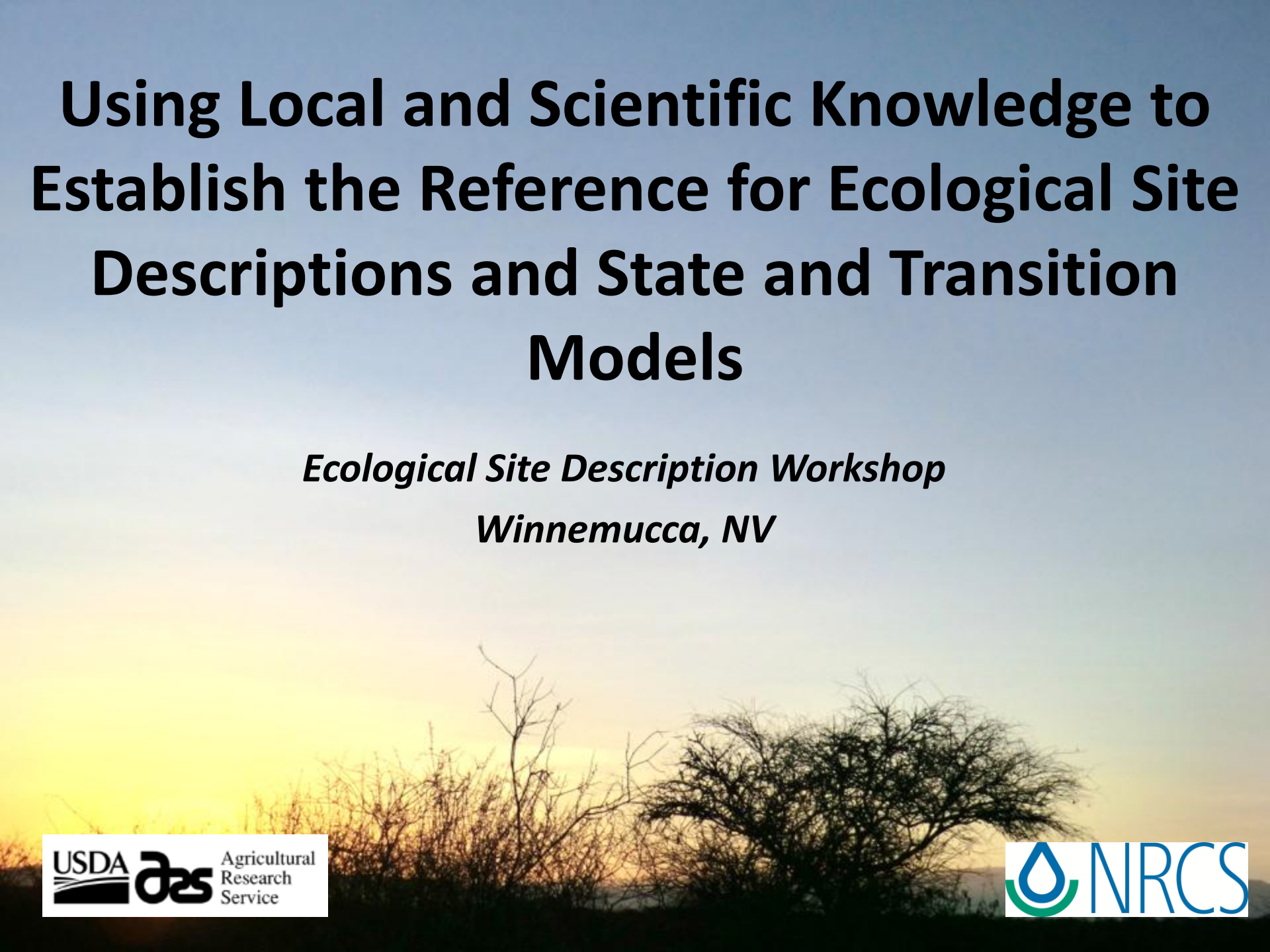
Using Local and Scientific Knowledge to Establish the Reference for Ecological Site Descriptions and State and Transition Models

Ecological Site Description Workshop

Winnemucca, NV




NRCS


NA'MIBIA RED CROSS SOCIETY
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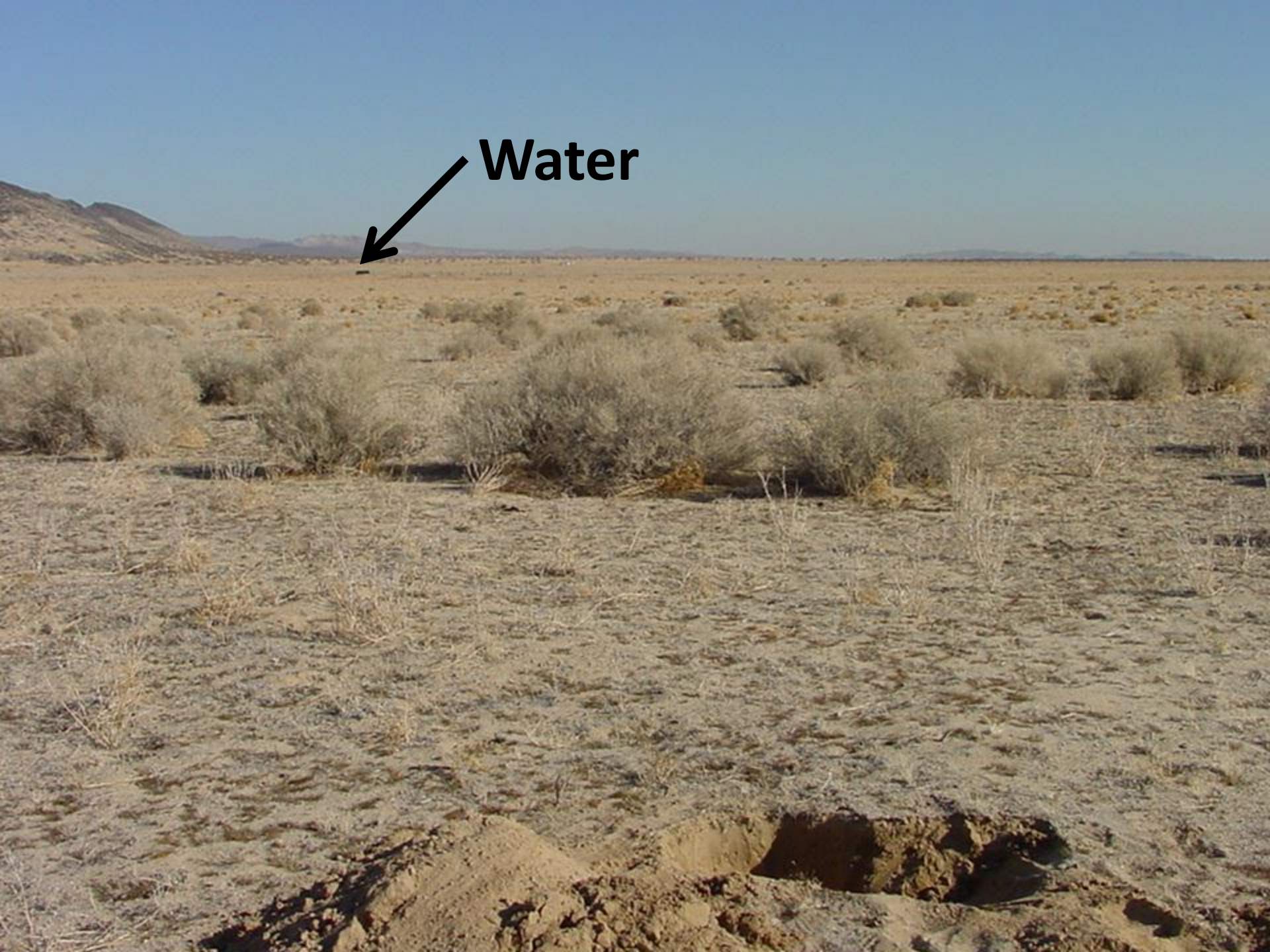
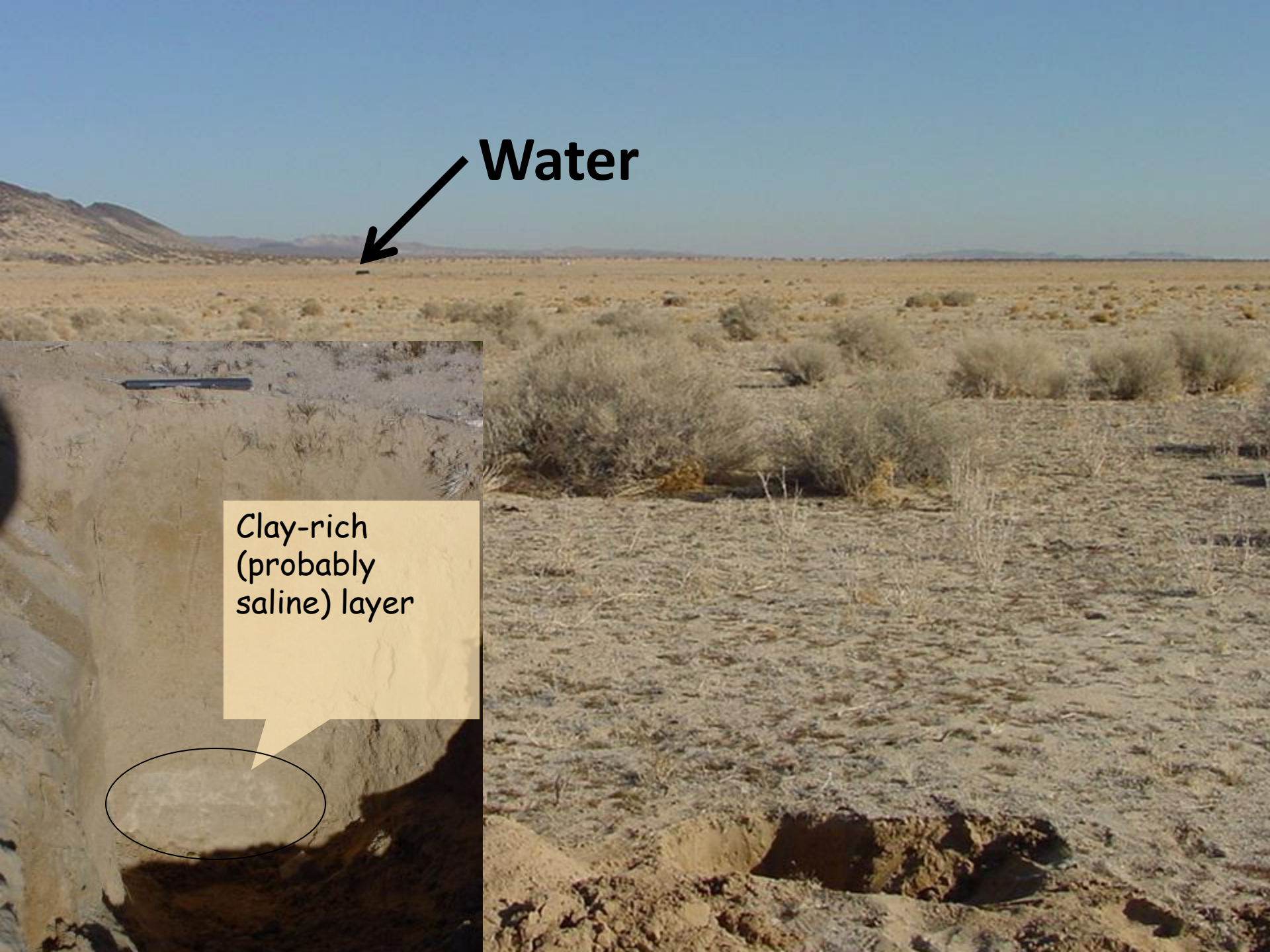
Ecological site: a kind of land with specific physical characteristics, which differs from other kinds of land in its ability to produce distinctive kinds and amounts of vegetation and in its response to management.


Water

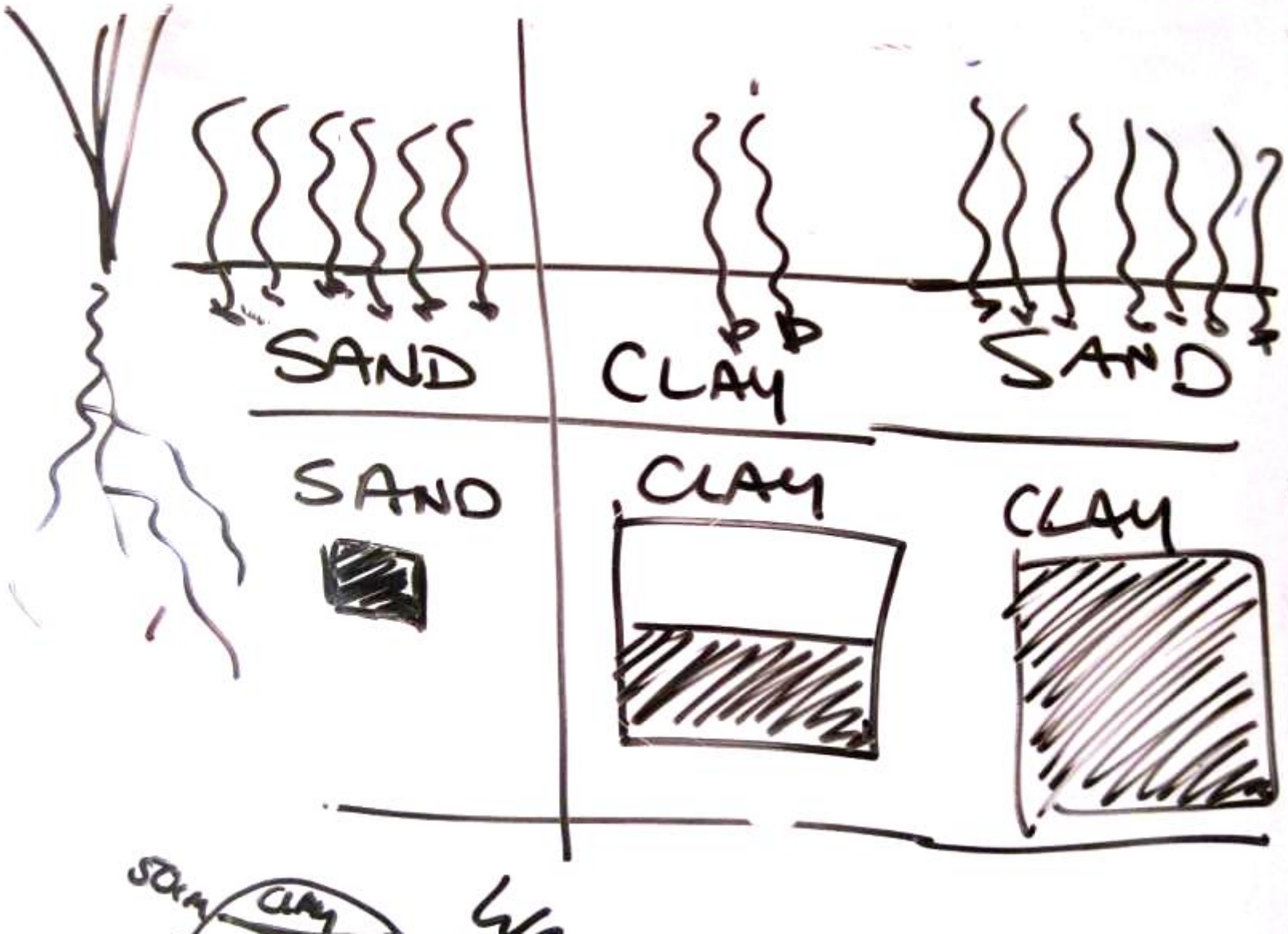

Water
Clay-rich (probably saline) layer

Ecological site: a kind of land with specific physical characteristics, which differs from other kinds of land in its ability to produce distinctive kinds and amounts of vegetation and in its response to management.

Ecological site: a kind of land ***with specific physical characteristics***, which differs from other kinds of land in its ability to produce distinctive kinds and amounts of vegetation and in its response to management.

What characteristics determine productivity?

Ecological site: a kind of land with specific physical characteristics, which differs from other kinds of land ***in its ability to produce distinctive kinds and amounts of vegetation*** and in its response to management.


SAND
CLAY
SAND
SAND
CLAY
CLAY

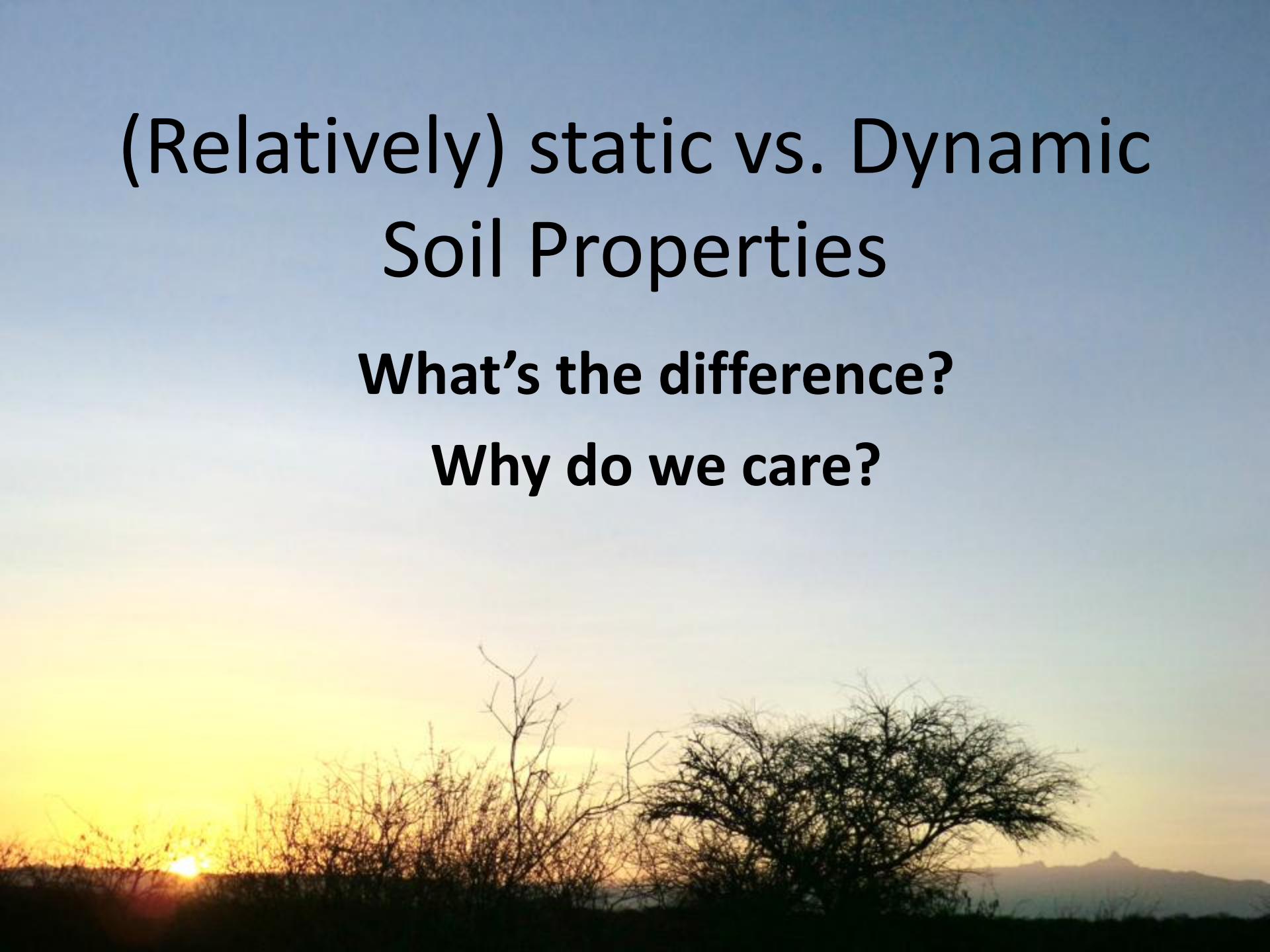
What characteristics determine short- and long-term response to management?

Ecological site: a kind of land with specific physical characteristics, which differs from other kinds of land in its ability to produce distinctive kinds and amounts of vegetation ***and in its response to management***.

(Relatively) static vs. Dynamic Soil Properties

What's the difference?

Why do we care?



(Relatively) static vs. dynamic soil properties

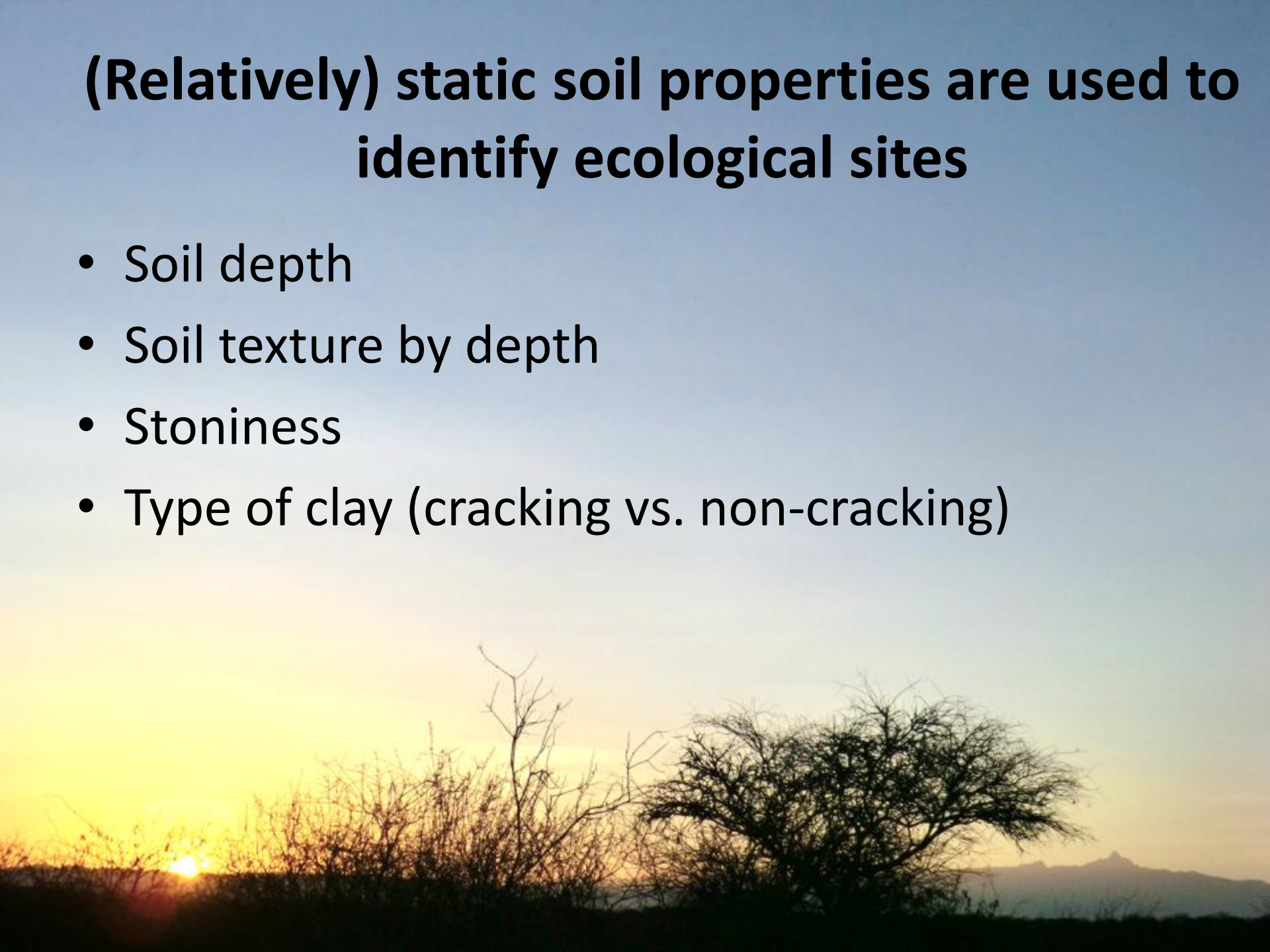
- (Relatively) static properties:
  - are used to define soil map unit components (and therefore ecological sites)
  - change little in response to differences in management and vegetation
- Dynamic properties:
  - are used to define the relative condition of the soil
  - change in response to differences in management
  - are related to changes in erodibility, infiltration, nutrient availability, etc...

Factors associated with (relatively) static vs. dynamic soil properties

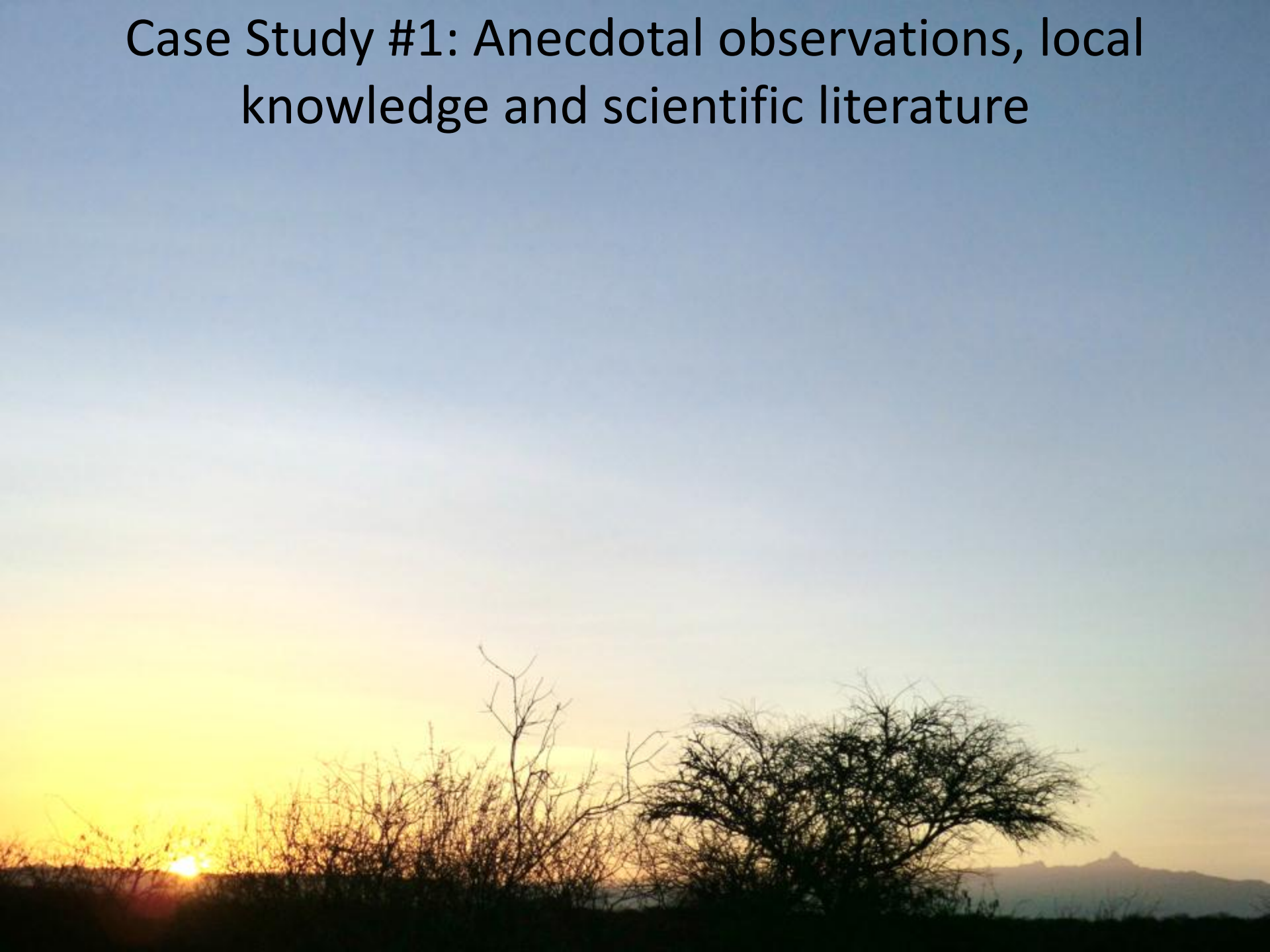
- (Relatively) static properties associated with:
  - parent material and soil profile development (mineralogy, depth, texture)
  - landscape position (long-term source/sink for sediment, water and nutrients)
- Dynamic properties associated with:
  - vegetation
  - soil biotic activity (from bacteria to badgers)
  - above-ground disturbance and short-term erosion/deposition (surface texture, infiltration capacity, microbiotic crusts)

(Relatively) static soil properties are used to identify ecological sites

- Soil depth
- Soil texture by depth
- Stoniness
- Type of clay (cracking vs. non-cracking)



Case Study #1: Anecdotal observations, local knowledge and scientific literature



Developing State-and-Transitions Models
Deep Sand Savannah Ecological Site

- 5500 – 6500 ft. elevation
- Flat to rolling dune topography
- Aeolian sand deposits – Deep, fs, lfs; lfs, fsl
- 13 – 16 in. average annual precipitation
- 75 % of precipitation comes during late growing season (late July, August and early Sept.)
- 130 – 160 day growing season (early May to early Oct)

Historical Accounts

- Golden-grassed plains
  - Spanish mission early 1600's– (Horgan, 1954)
    - Abandoned 1671
- Good grass cover, scattered piñon and juniper (McLeullough, 1882)
- Treeless but very grassy with sabinos (junipers) dotting it (Bandelier, 1884)

Natural Range of Variability

- Fire maintained grassland or savannah aspect (Natural and human ignition)
  - 4 – 6 years (Frost, 1998)
  - 6 – 11 years (Baisan & Swetnam, 1997)
  - 16 – 20 years (Allen, 1989)
- Drought/Wet Years
- Herbivory
  - Blacktailed Jackrabbit
  - Pronghorn Antelope

Pre-Anglo/American Settlement

- Tall and mid warm season bunchgrasses
- Mid and short warm and cool season grass understory
- Forbs – variable with season and weather
- Woody – spatially and temporally variable depending on time since last fire
- Annual Production ~ 1200 lbs./ac.

Deep Sand Savannah

Post-Anglo/American Settlement Dynamics

- Large herds of livestock
  - 1870 - 1880 – < 1 million sheep & 137,000 cows
  - 1890 – 5 million sheep & 1.3 million cows
  - 1906 – 6 million sheep & 1 million cows
  - 1979 – 600,000 sheep & 1.5 million cows
  - 2007 – 127,000 sheep & 1.5 million cows
- Fire suppression
  - Lack of fine fuel
  - Active suppression

Present

- One-seed juniper > 12 ft. tall
- Juniper canopy cover 15 - 25%
- Annual herbaceous production 100 – 200 lbs/ac

Deep Sand Savannah

thresholds

Vegetation attribute(s)

Feedback mechanisms

transitions

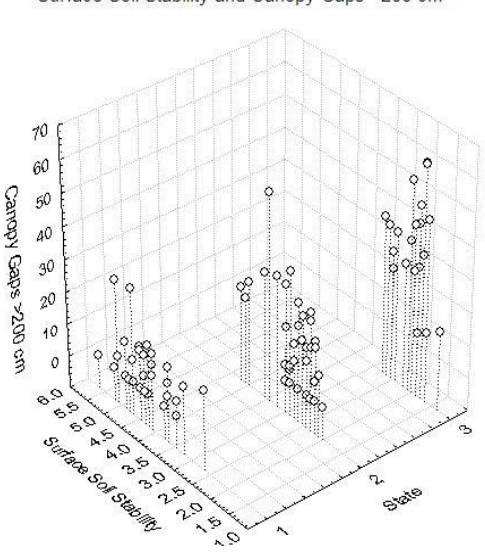
time

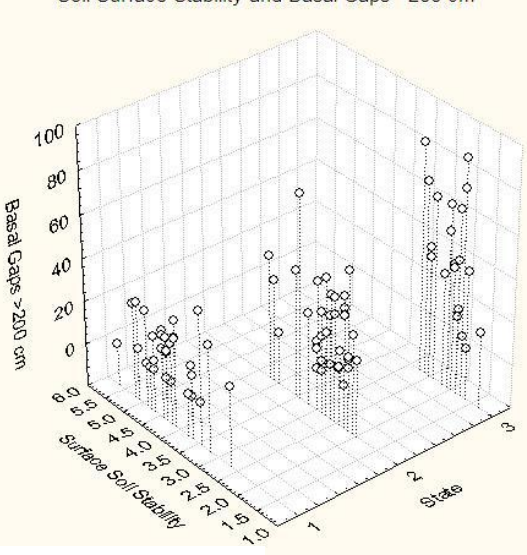
State-and-Transition Model

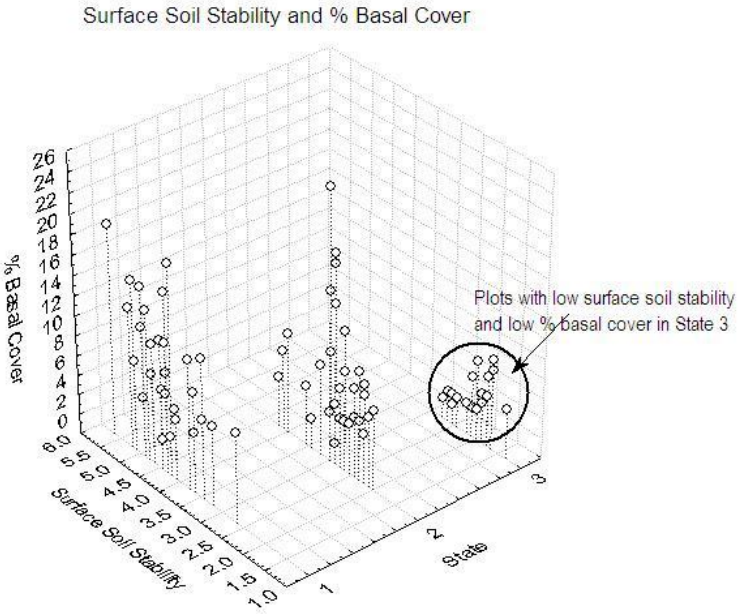
	Reference State 1.0	Juniper State 2.0	Eroded State 3.0
Surface Soil Stability	>4.0	2.6 – 3.0	< 2.4
Subsurface Soil Stability	>2.4	1.6 – 1.8	< 1.6
Canopy Gaps > 200cm	<10%	10% - 20%	> 28%
Basal Gaps > 200cm	< 17%	17% - 29%	> 33%
Basal Cover	>7%	5% - 9%	< 4%
Juniper Foliar Cover	<17%	18% - 27%	>20%
Herb. Foliar Cover	>45%	>45%	<41%
Bare Ground	<33%	28% - 37%	>39%

Values are within 95% C.I. of the mean.

State-and-Transition Model







State-and-Transition Model

- Reference State
  - Six transects
    - Both soil stability measurements <95% C.I.
    - At least one gap measurement >95% C.I.
  - Two transects
    - Surface or subsuface <95% C.I.
    - Both gaps measurements >95% C.I.
- Juniper State
  - Five transects
    - Both soil stability measurements >95% C.I.
    - At least one other variable >95% C.I.

Means and 95% C.I. for these 13 transects were computed
Repeated this process for Juniper State and Eroded State
Developed quantitative matrix of components for each community phase

State-and-Transition Model

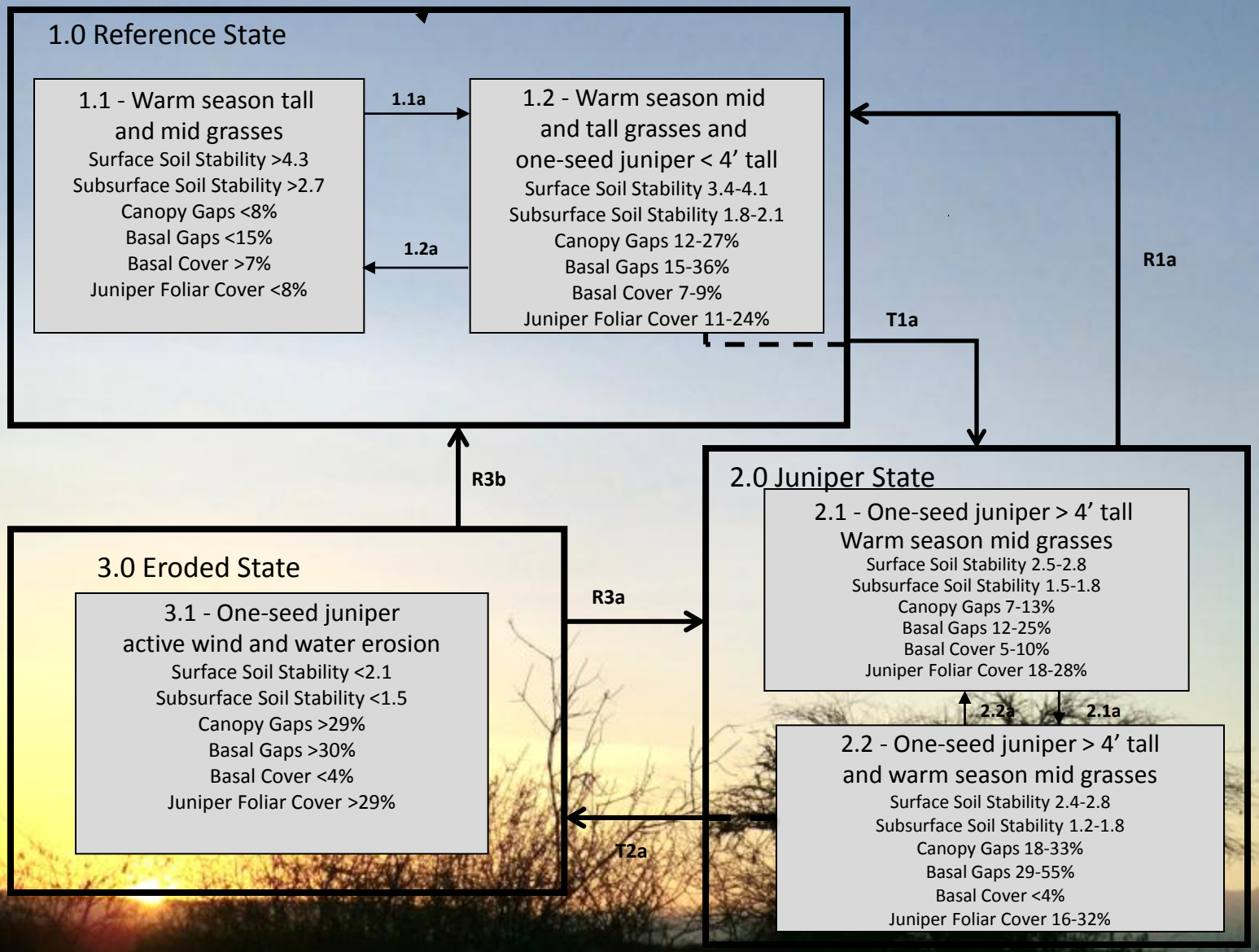
	Reference State 1.0	Juniper State 2.0	Eroded State 3.0
Species	Lbs./ac.	Lbs./ac.	Lbs./ac.
Sand Bluestem	400 - 500	100-150	0
Little Bluestem	300 - 400	150 - 300	0 - 50
Sideoates Grama	100 - 150	100 - 150	0 - 20
Indian Ricegrass	80 - 150	50 - 75	0 - 10
Sandhill Muhly	0 - 25	20 - 80	100 - 120
Sand Sagebrush	0 - 20	50 - 150	0 - 20
One-seed Juniper	0 - 50	230 - 350	400

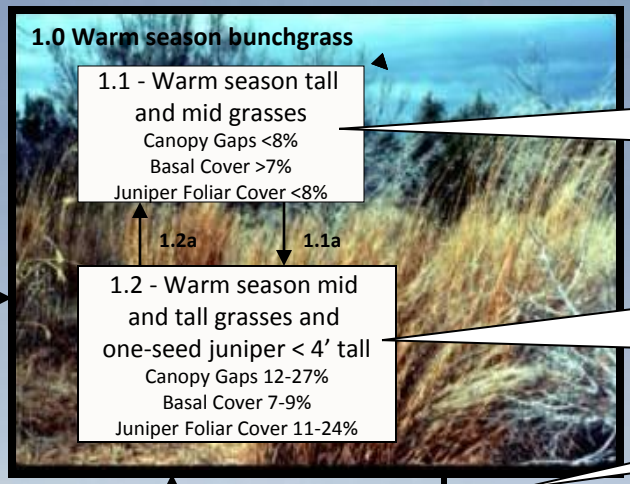
State-and-Transition Model

State	Reference State		Juniper State		Eroded State
Community Phase	1.1	1.2	2.1	2.2	3.1
Surface Soil Stability	>4.3	3.4 – 4.1	2.5 – 2.8	2.4 – 2.8	<2.1
Subsurface Soil Stability	>2.7	1.8 – 2.1	1.5 – 1.8	1.2 – 1.8	<1.5
Canopy Gaps > 200cm	<8%	12 – 27%	7 – 13%	18 – 33%	>29%
Basal Gaps > 200cm	<15%	15 – 36%	12 – 25%	29 – 55%	>30%
Basal Cover	>7%	5 – 9%	5 – 10%	<4%	<4%
Juniper Foliar Cover	<8%	11 – 24%	18 – 28%	16 – 32%	>29%
Herb. Foliar Cover	>46%	40 – 54%	47 – 57%	32 – 46%	<30%
Bare Ground	<32%	24 – 42%	27 – 37%	33 – 47%	>39%

Value ranges within 95% C.I. of the mean

State-and-Transition Model





1.1a: " …time since last fire or by a series of dry years followed by wet years. … opportunity for juniper seedling establishment increases. … decreases herbaceous production, crown cover and organic matter input into the soil, … allow juniper seed germination and establishment…"

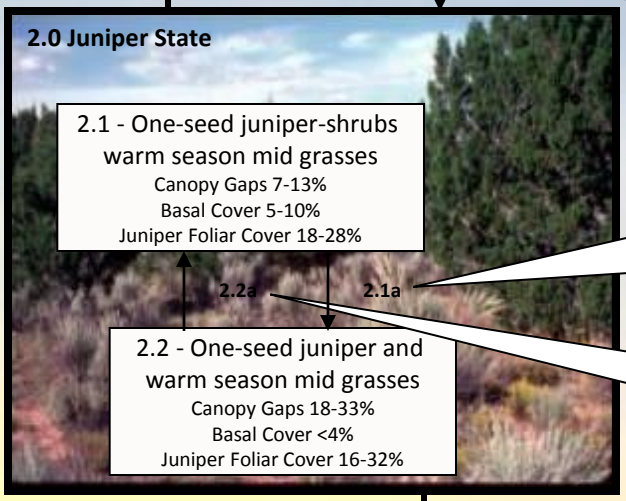
1.2a:"…fire frequency allows for ground fires that remove juniper seedlings and established plants less than 1.5 meters tall…"

T1a: "… slow variables and triggers for this transition are the elimination of fire due to decrease in fine fuels allowing juniper canopy. The threshold values…surface soil stability < 3.4, basal cover <7%, juniper foliar cover >24%, juniper >4' tall..."

R2a

T1a

R2a:"…removal of juniper canopy cover to < 5% with minimal soil surface disturbance… management actions that increases herbaceous production and favors the establishment and growth of warm season tall and mid grasses…"

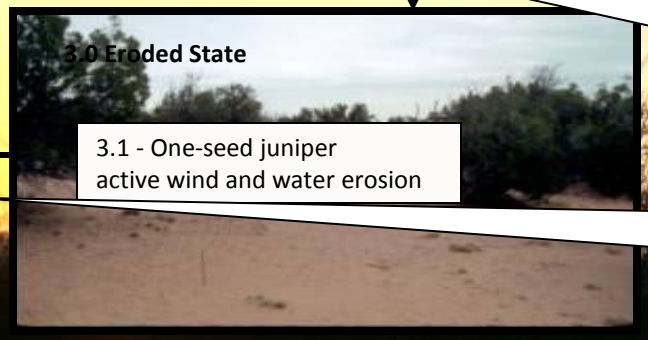


2.1a:"…juniper canopy increases with time since last fire ...other management action to reduce juniper canopy…increase in juniper canopy decreases shrub and herbaceous production and cover…shrubs and tall grasses decrease or are eliminated…drought years followed by wet years will allow for increase in juniper establishment..."

2.2a:"…management actions that decrease juniper canopy and increase herbaceous and shrub production…can include prescribed burning, chemical or mechanical brush management, while other management actions are aimed at increasing herbaceous production…"

T2a

T2a:"…slow variables and trigger for this transition are increase in juniper seedling establishment and juniper cover…caused by management actions that lead to decreased herbaceous production and decreased organic matter inputs…by lack of management actions that actively reduce juniper canopy cover…threshold values...surface soil stability <2.4, bare ground >40%, canopy gaps >30%, basal cover <4%. …"



R3a

R3a:"…management and restoration planned must decrease juniper canopy to <5%...little or no surface disturbance, management actions must increase herbaceous production…allow for litter accumulation…improve organic matter inputs to stabilize soil surface…"

Case Study #2 Anecdotal observations and structured data collection

NW Namibia (-19°S 12-17” ppt?)

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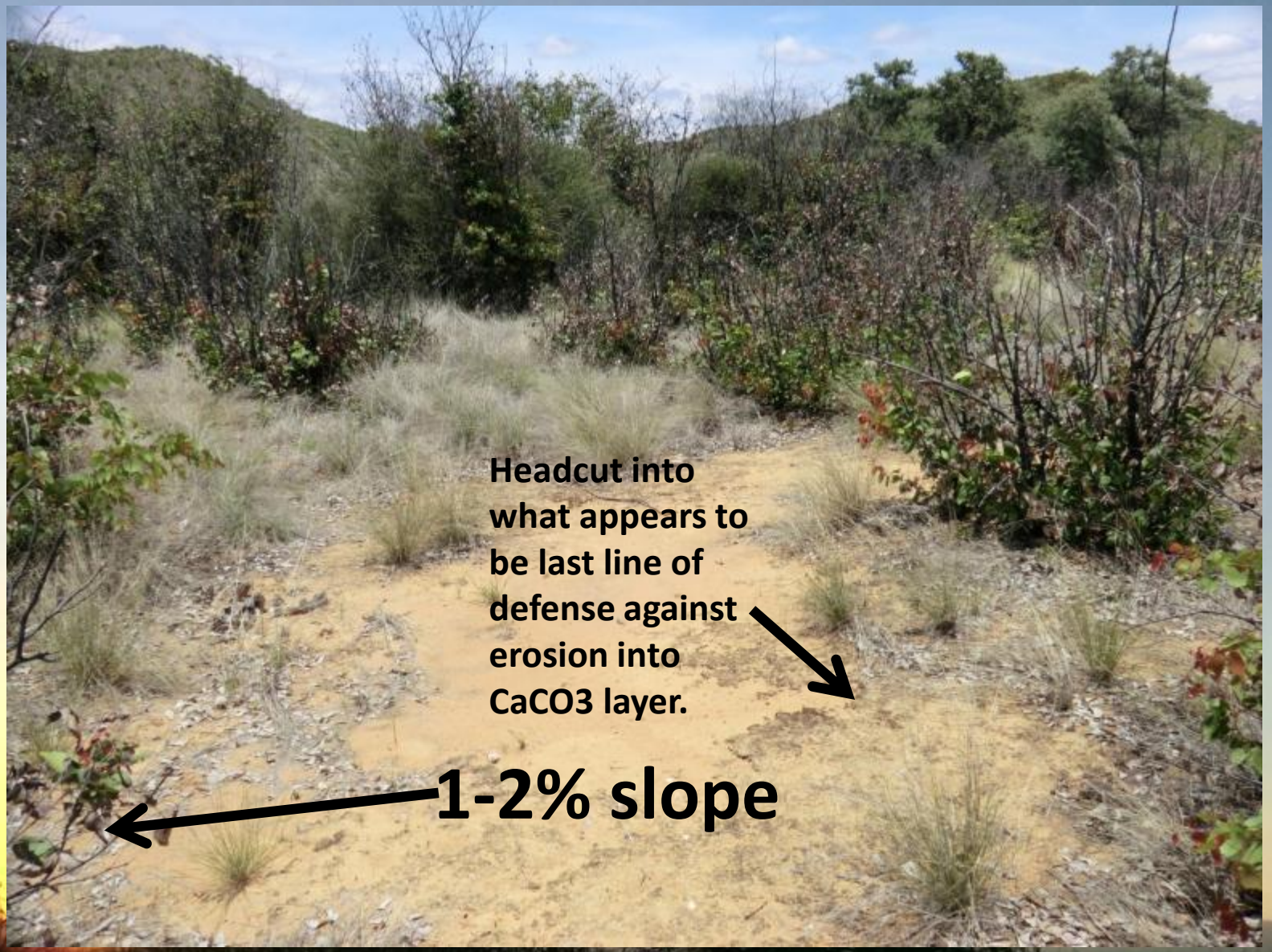

NW Namibia (-19°S 12-17” ppt?)

*What's **possible** depends on **soils** and **climate (= ecological site)***

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Questions?

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