Steps in Producing Ecological Site Descriptions: A Perspective from Arizona.

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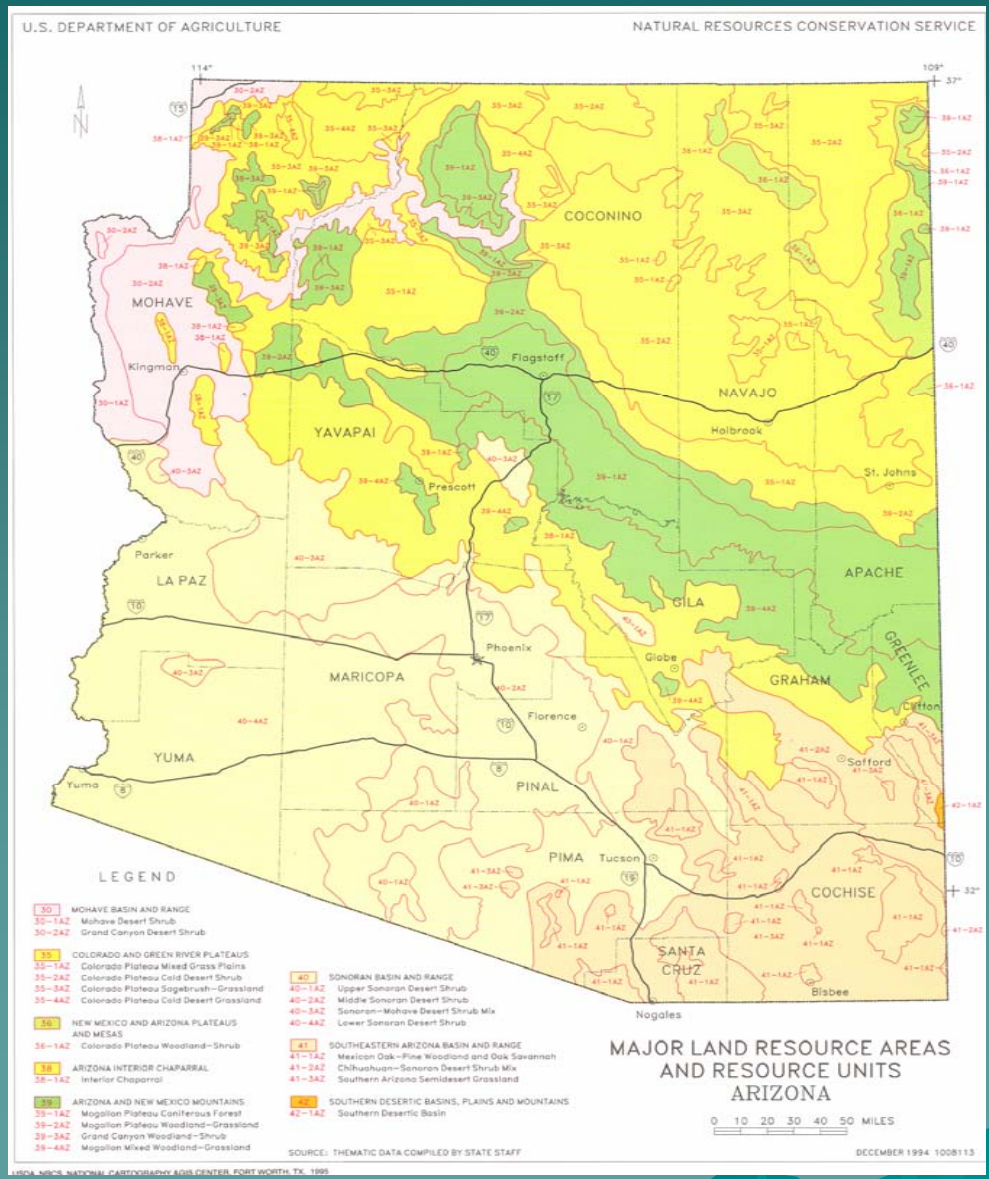
Land Classification by NRCS

- MLRA – Major Land Resource Area – MLRAs represent ecosystems in Ariz. An ecosystem is a naturally interacting community of plants, animals and their surrounding environment. MLRA boundaries in Ariz. correspond to regional ecosystem boundaries. Thus; MLRA 40 is the Sonoran desert, MLRA 30 is the Mohave desert and MLRA 41 is the Madrean Basin and Range province.

MLRAs and Common Resource Areas

- CRAs - Common Resource Areas – Common Resource Areas in Arizona are the life-zones within an ecosystem (MLRA). They are defined by climate (temperatures, precipitation), elevation and other biotic and abiotic characteristics that set them apart from one another. There are three CRAs in MLRA 41 defined by precipitation zones and elevation.

Arizona MLRAs



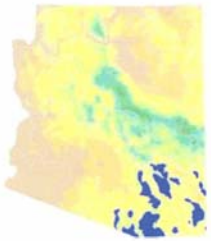
MLRA 41

Madrean Basin and Range

This region has been divided into three resource areas

Mexican Oak-Pine Forest and Oak Savannah

This resource area is characterized by valley plains, alluvial fans, and hills. Sediments are fluvial, colluvial and alluvial deposits. Igneous and metamorphic rock dominate the hills. Elevations range from 4500 to 10,700 feet. Precipitation ranges from 16 to 30 inches.



The lowest precipitation zone with 16 to 20 inches mean annual precipitation occurs at elevations from 4500 feet on north exposures to 6500 feet on southern ones. The potential natural vegetation here is oak - Savannah with open canopies (5-10%) of Emory, Mexican blue, Arizona white oak, and one seed juniper and perennial grasses in the understory. The major grasses include sideoats, blue, hairy and purple gramas, bullgrass, deergrass, Texas bluestem, plains lovegrass, woolly bunchgrass, crinkleawn, prairie junegrass, squirreltail, pinyon ricegrass, and beggartick threeawn. The dominant shrubs are sacahuista, California bricklebush, wait-a-bit mimosa, and yerba de pasmo. Average annual production of these grasslands is about 1500 pounds per acre.

Above 20 inches mean precipitation, woodlands are the potential. In the 20-27 inch precipitation zone, at elevations from 5500 feet on northern aspects up to 7500 feet on southern ones, the woodland is dominate by evergreen live oak, juniper and pinyon. The dominant trees include Arizona white, Emory, and silverleaf oaks, alligator juniper, and Mexican pinyon. Associated shrubs are manzanita, mountain mahogany, silktassel, skunk bush sumac, sacahuista, Arizona rosewood, macrosiphonia, and bundleflower. Important grasses are sideoats grama, plains lovegrass, pinyon ricegrass, muttongrass, prairie junegrass, and bullgrass.

There are no perennial streams in this unit. Streams flow during the spring snow melt and following heavy summer rains. There are a few small man-made lakes in the area which are used exclusively for recreation. Except for a short period during the spring snow melt period, groundwater is deep and in very short supply. The mountainous watersheds of this resource unit area provide municipal and domestic water for several communities in adjacent areas. Examples include Safford using water from the Pinalenos and Gila Mountains and Tombstone and Fort Huachuca using water from the Huachuca Mountains.

Chihuahuan – Sonoran Desert Shrubs

This resource area is characterized by valley plains, alluvial fans, and hills. Sediments are fluvial, colluvial and alluvial deposits. Igneous and metamorphic rock dominate the hills. Elevations range from 2600 to 4000 feet. Precipitation ranges from 8 to 12 inches per year.

Potential plant communities in this resource unit are dominated by desert shrubs and trees with sparse covers of perennial grasses. The major perennial grasses are tobosa, black grama, purple and blue threeawns, bush muhly, sand, spike, and mesa dropseed, and burrograss. Sonoran desert shrubs mix with Chihuahuan species. The major trees include mesquite, catclaw acacia, canotia, and palo verde. Dominant shrubs include soaptree yucca, creosotebush, whitethorn acacia, rayless goldenhead, mariola, staghorn cholla, desert saltbush, shortleaf baccharis, Mormon tea, burroweed, snakeweed, and jimmyweed. Average annual production of these shrub lands is about 600 pounds per acre.

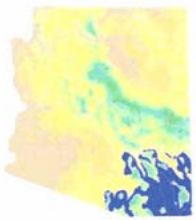
Wildlife species include javelina, desert mule deer, Gambel's quail, mourning and whitewing dove, jack rabbits, and cottontail. San Carlos Reservoir on the Gila River provides some of the best water fishing opportunities in this part of Arizona, as well as winter habitat for migratory waterfowl.

The Gila River flows through the northern segment of this resource area and is a perennial stream. There are no other perennial streams. There are no lakes or reservoirs. In the vicinity of San Simon, ground water from deep wells is pumped to obtain water for irrigating a relatively small area. Water is generally scarce. The drainage patter is well developed. Both the Gila and the San Simon have networks of prominent tributaries. Coolidge Dam on the Gila and two large structures on the San Simon (Fan, Barrier) provide base level control for the watersheds in this unit.

Nearly all of this area is grazed by livestock. Animal numbers fluctuate widely between years with favorable moisture and drought years. The water supply for wildlife and livestock in this resource area is mostly from pumped underground supplies. Although there are some stock ponds in this resource area, the low annual rainfall makes them unreliable unless they are very large, and capture water from large watersheds or they are located adjacent to bedrock slopes that produce higher runoff during storm events.

Chihuahuan – Sonoran Semidesert Grasslands

This resource area is characterized by valley plains, alluvial fans, and hills. Sediments are fluvial, colluvial and alluvial deposits. Igneous and metamorphic rock dominate the hills. Elevations range from 3200 to 5000 feet. Precipitation ranges from 12 to 16 inches per year. Vegetation includes sideoats grama, black grama, plains lovegrass, and tobosa.



Sonoran desert influences on the west side of this resource area result in the occurrence of shrubs like jojoba, blue palo verde, staghorn and jumping cholla, and fishhook barrel cactus in the plant communities. Chihuahuan desert influences on the east side of the resource area result in the occurrence of shrubs like mariola, mortonia, chittam, tarbush, whitethorn acacia, and littleleaf sumac in the plant communities. Wildlife species include javelina, desert mule deer, pronghorn antelope, Coues whitetail deer, and desert bighorn sheep. Other wildlife species include Gambel's and scaled quail, mourning dove, cottontail, and jack rabbits. Over 12,000 sandhill cranes winter in the Willcox Playa and the cienegas in the Sulphur Springs Valley.

Ecological Sites

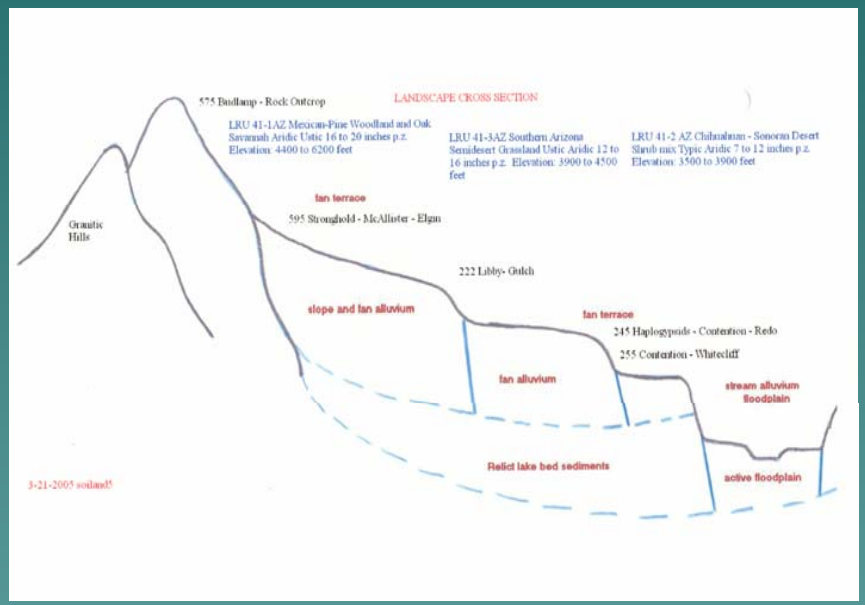
Ecological sites are components of life-zones within ecosystems. They are useful for land inventory, classification and management. By definition, they are; “A distinctive kind of land with specific physical characteristics that differs from other kinds of land in its ability to produce a distinctive kind and amount of vegetation”.

Ecological Sites

Systematic process

- Soil Survey is the foundation inventory
- Range specialist work with soil scientists to correlate vegetation to soils
- Soil moisture and temperature regimes correspond to CRA boundaries
- Soils are grouped together in their ability to produce a plant community and with similar ecological processes
- Plant community attributes are measured
- Ecological site concepts are developed
- Ecological site descriptions are written
- The process is evolutionary and on-going

Soil Scientists work out the basic soil - landscape relationships



Soil series are established, described and correlated to the National Soils Taxonomy

Range Specialists describe and compare the plant communities on the different soils being mapped

Ecological site concepts are developed

- Site names are descriptive; they usually contain soil textures, chemistry, parent material and position.
- Textures include, sandy, sandyloam, loamy clayloam and clayey
- Chemistry may include adjectives like limy, gypsic and saline
- Parent material may be granitic, volcanic, limestone, sandstone, etc.
- Position includes, upland, slopes, hills, bottoms cienegas and swales.
- A naming convention is being developed for Ariz.

Ecological processes are similar for soils grouped into an ecological site

- Hydrology (infiltration/runoff)
- Energy flow (warm vs. cool season)
- Nutrient flow (grassland, shrub-land)
- Soil erosion (natural rates of soil weathering and movement by wind and water)
- Soil deposition (frequency, amounts)
- Soil formation

Ecological Processes cont.

- Precipitation (kind, amount, timing and variance)
- Plant succession
- Drought, flood (El Nino), (frequency, severity)
- Plant, animal invasions (ranges contracting or expanding)
- Over population
- Population crashes
- Grazing (native grazers, browsers)

Ecological Site Descriptions are developed

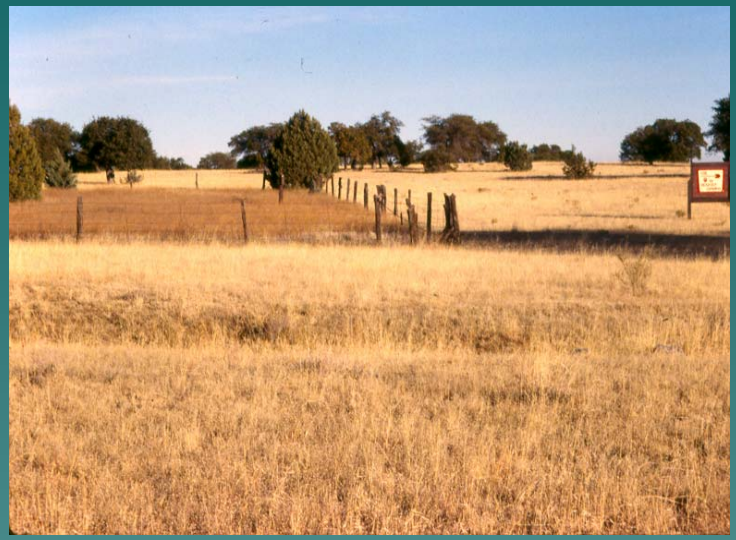
- Plant Communities are described as the best (most cover, production and diversity) we have been able to find to date.
- Plant groups (life forms) and ranges in plant community and site characteristics help accommodate the variability found across a CRA (common resource area)
- Reference areas are used to help develop descriptions of potential plant communities
- Historical evidence shows gross changes that may have occurred
- Research helps quantify biotic and abiotic processes
- Vegetation monitoring shows plant community trend and trajectory
- As climate changes and invasions & extinctions occur, site potentials will change
- Site descriptions need up-dating every 15-20 years to include new information from soil and vegetation surveys.

Variability in plant communities, ranges in soil characteristics, climatic zones

Volcanic Hills, CRA 38-1 12-16” pz.

NWS climate station at Coolidge dam

Reference Areas



Vaughn enclosure, Canelo

West pasture enclosure, Empire

Enclosure # 22 SRER

Dos Cabezas cemetery

Historical Information

Fort Huachuca, south range 1917

Fort Huachuca, south range 1997

Border monument # 138, 1893

Border monument # 138, 1983

Research and Monitoring of Ecological Site Processes

ARS Rainfall Simulator on Loamy upland

Babacomari Ranch stream gage at KA # 23

Woodling Ranch watersheds

Santa Rita watershed

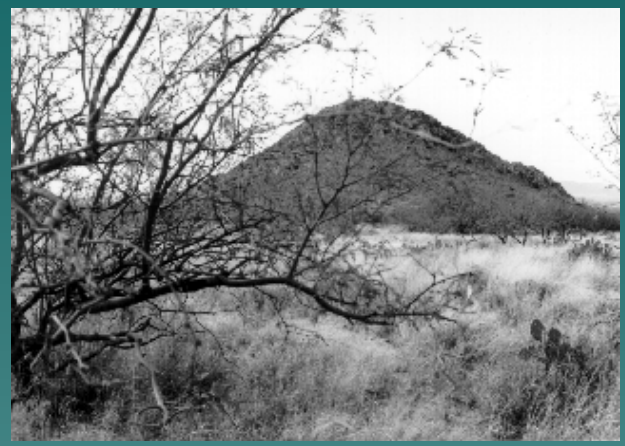
Monitoring Vegetative Trends

Vaughn enclosure 1961

Vaughn enclosure 2005

Monitor Vegetative Trends, cont.

1902



1987

1941

SRER photo station #233
Just east of Huerfano Butte

State and Transition Models

- State and Transition Models – these models are conceptual theories about how plant communities change (plant succession) over time.
- States are plant communities which have crossed some threshold (soil erosion, vegetative or ecologic process) which does not allow a return to potential conditions.
- Thresholds occur where ecological processes have been altered. They can be biotic or abiotic.
- Transitions are important to describe; they include a time dimension, a physical dimension and disturbance regime.

Los Encinos Ranch near Sasabe, Arizona, North Encinos pasture at Key Area # 2

Species	1983	1984	1985	1986	1988	1990
Snakeweed	76	74	55	65	19	24
Burroweed	28	20	15	9	3	7
Mesquite	3	4	2	6	10	11
Lehmann	6	1	32	33	65	80
Spidergrass	9	19	15	16	28	13

Pace-frequency monitoring transect at KA # 2, grazed every other summer

1983

1984

1986

1988

Sandy Loam Upland, deep

- MLRA 41-3 12-16”pz
- Combate soil series
- Desert grassland
- Enclosure #22, SRER
- Soil is young, deep
- Dark colored, non limy
- Sandyloam throughout
- On fan terraces

SRER 1902

SRER 2002

States

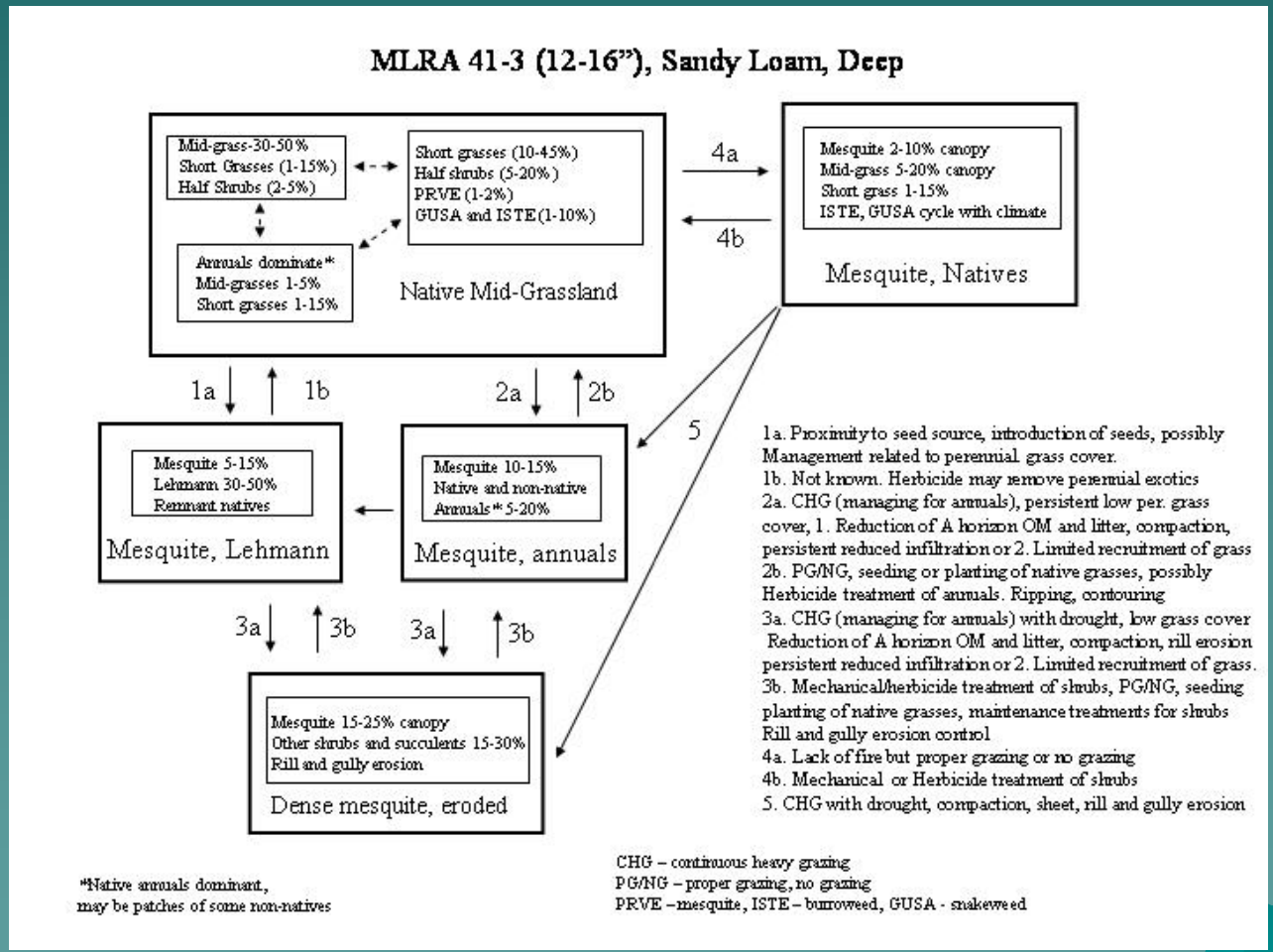
Mesquite, native grasses

Mesquite, annuals

Dense mesquite, eroded

Lehmann lovegrass

Sandy Loam Upland, deep 12-16” State and Transition Model



Rangeland Health

- The degree to which the integrity of the soil, vegetation, water and air, as well as the ecological process of the rangeland ecosystem, are balanced and sustained.
- Qualitative assessment of three attributes of rangeland ecosystems
  - Soil / site stability
  - Hydrologic function
  - Integrity of the biotic community
- Evaluation of 17 indicators that affect these ecosystem attributes
- Rangeland health rates ecosystem attributes in three categories;
  - compromised (unstable)
  - at risk
  - Healthy, functioning (stable)

Conditions near enclosure # 22 on and off the SRER

SRER, inside enclosure # 22

SRER, outside enclosure # 22

SRER, boundary near # 22

Outside SRER near # 22

Rangeland Health Reference Area Worksheet from enclosure # 22 on the SRER in Helvetia area

- **Rills** – None
- **Water flow patterns** – 10-15% of area, short (3-5 ft.) discontinuous in length
- **Pedestals and terracettes** – Pedestals infrequent on perennial grasses, terracettes 10 to 15 feet apart with 1 inch elevation difference from above to below (in black grama areas, terracettes are 2 to 5 feet apart).
- **Bare ground** – 22% (following several years of drought)
- **Gullies** - None
- **Wind scour** – None
- **Litter movement** – All litter size classes stay in place
- **Soil surface resistance to erosion** – Values of 4 to 6 from slake test
- **Soil surface structure** – Weak granular, soil color is 10 YR 3/2 dry, 10 YR 2/2 moist, Organic matter 2-3% from lab data from soil survey (SRER), cover is well dispersed throughout the site
- **Plant cover and runoff** – Canopy cover perennial grasses 31%, basal cover 6%, litter cover 76%, gravel cover 5% (after 4-5 years drought), surface thickness is 10+ inches

Rangeland Health Reference Area Worksheet from enclosure # 22 on SRER, cont.

- **Compaction layer** – None, penetrometer (2 kg. hammer from height of 2.24 feet) 5 blows penetrated 3.55 inches (S.D.=0.59 inches)
  - Outside enclosure, on SRER, 5 blows penetrated 1.84 inches (S.D.=0.22)
  - Outside SRER, 5 blows penetrated 1.35 inches (S.D.=0.24)
- **Plant functional groups** – Perennial mid-grasses> annual forbs and grasses> shrubs> succulents> perennial short grasses (El Nino year)
- **Plant mortality** – About 50% of the basal cover of perennial mid-grasses and 80% of the basal cover of perennial short grasses has been lost to prolonged drought
- **Litter cover and depth** – 76% cover, 0.5 inch depth
- **Annual production** – dry year = 600 lbs/ac., average year = 1100 lbs/ac., wet year 1800 lbs/ac.
- **Invasive species** – Lehmann lovegrass, Boer lovegrass, bufflegrass, mesquite
- **Reproductive capability** – Not impaired even after several years of drought. Black grama producing stolons, all other species producing viable seeds

Tools to help in determining Rangeland Health

Soil penetrometer

Definitions, rills, etc.

Soil slake test

Where to find these materials

- http://esis.sc.egov.usda.gov
  - Approved reports, ecological sites
- http://www.az.nrcs.usda.gov
  - Field Office Technical Guide, Sec. 2
- http://www.soils.usda.gov
  - Soils Data Mart, soil survey reports

Summary

- Ecological site development continues (NRCS, ARS, BLM, USFS)
- New rangeland theory of plant succession is incorporated (State and Transition)
- New assessment techniques are developed (Rangeland Health)
- Long time research sites like SRER and Jornada provide invaluable information in this process
- Range research will test new theory
- Ecological Site descriptions must be updated on a regular schedule as new information becomes available and as climate changes

The End