Soil Health Management and Assessment in Rangelands

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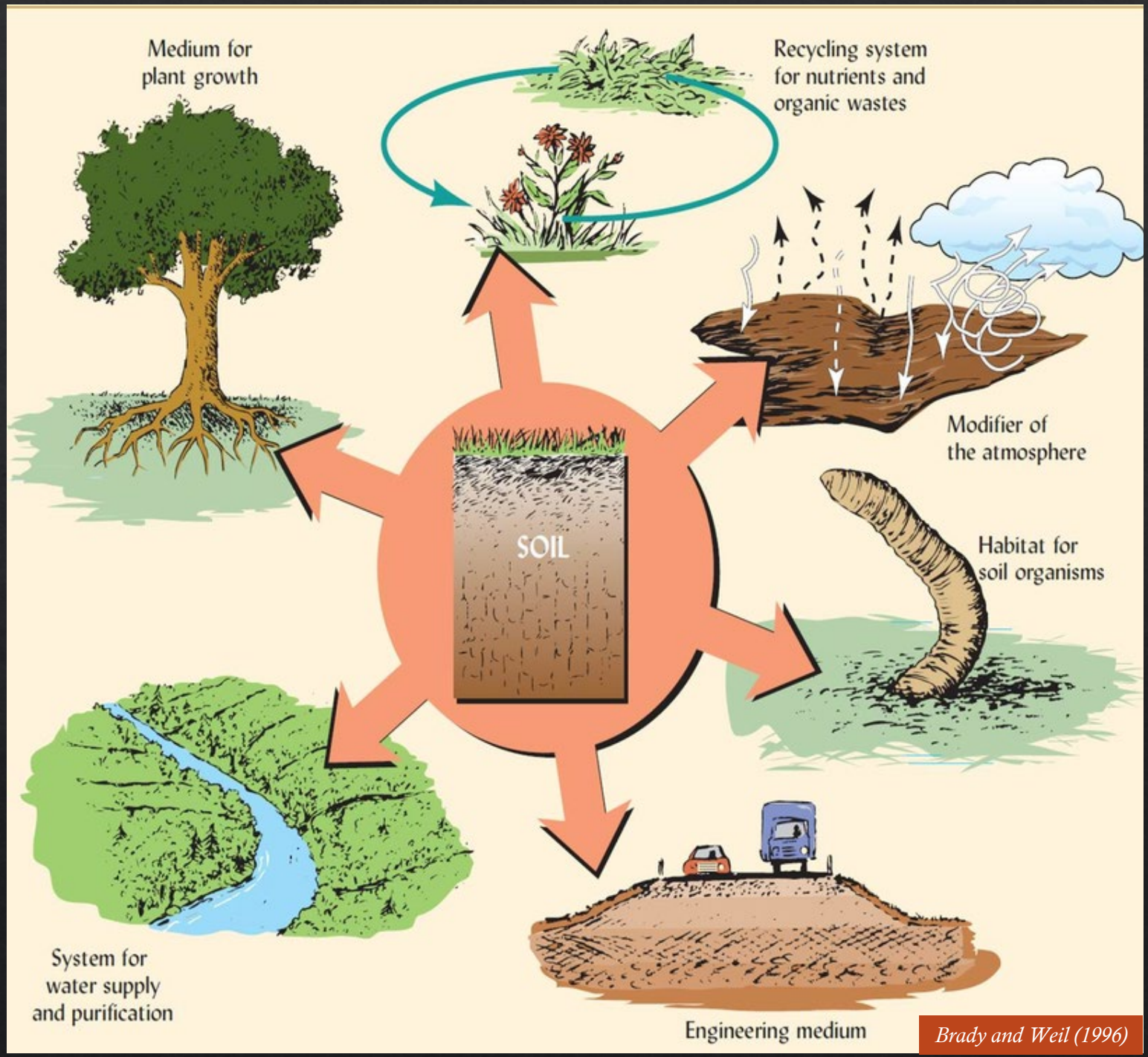
What is *Soil Health*?

The continued *capacity* of soil to **function** as a vital living system, within ecosystem and land-use boundaries, to ***sustain*** biological productivity, promote the ***quality*** of air and water environments, and maintain *plant, animal, and human* health

(Doran and Zeiss, 2000)

Soil *Functions*

- Element cycling
- Store Carbon and Water
- Shelter Biology
- Gaseous exchange



Brady and Weil (1996)

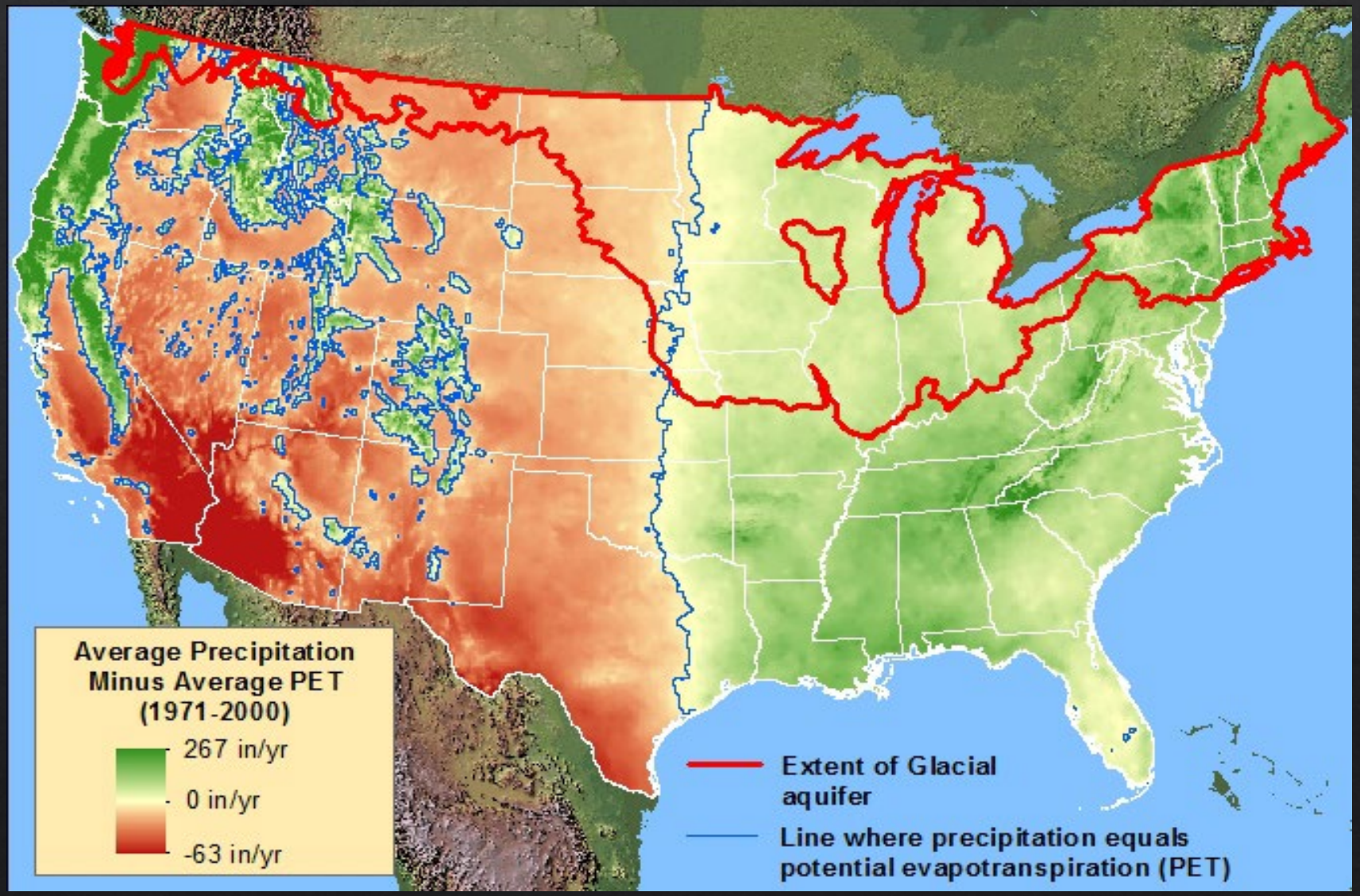
Soil Health Principles

Soil Health *Indicators*

Soil Health Barriers in Arizona

- **Water** scarcity
- **Salt-**affected soils
- Organic matter decomposition
- Survival of soil organisms

Precipitation < Evapotranspiration



SOM: Decomposition > Build-up

Rangeland Soil Health: Why do we *care*?

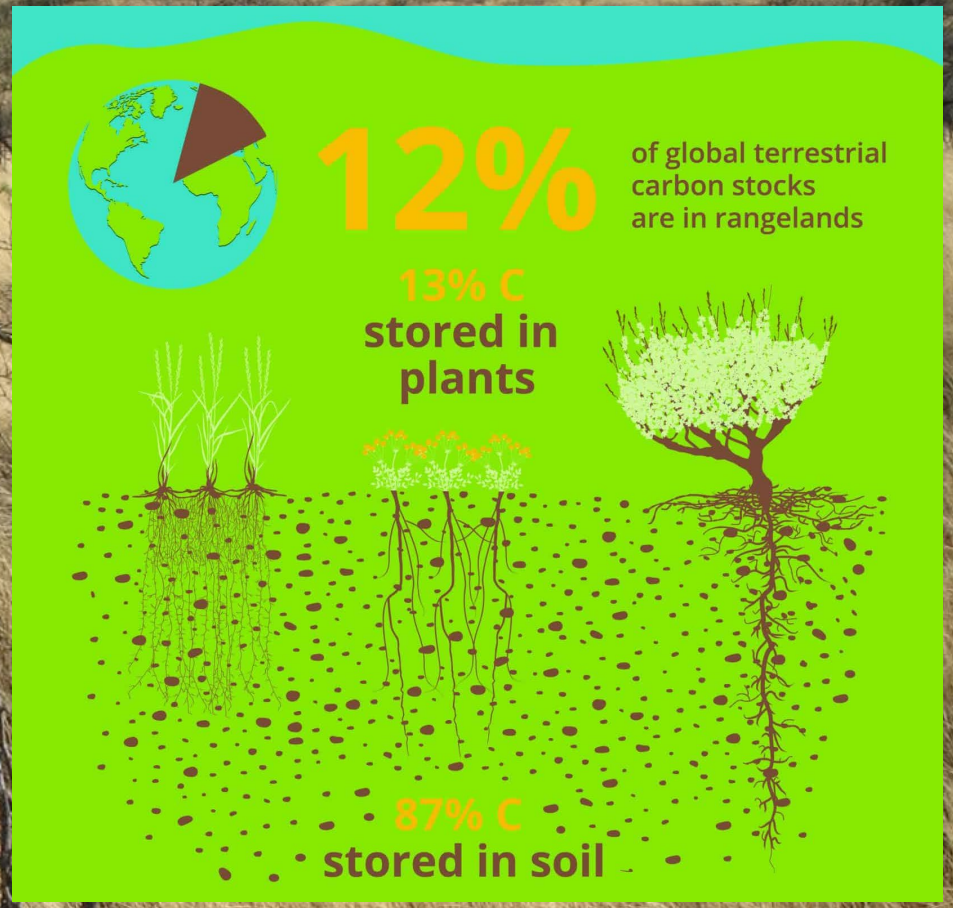
- Nutrient Cycling: fertile rangelands
- Water Dynamics and Storage
- Physical Stability/ Porosity, soil aggregation
- Resistance and Resilience against extreme events
- Biodiversity and Habitat: plant and animal spp.
- Filtering and Buffering unwanted elements

Significance of Rangeland Management

- Rangelands are native habitats to hundreds of plant species, birds, reptiles, and insects
- Ranching industry: ~US $8 billion
- A vast store of carbon, both in soils and vegetation
- Carbon sequestration: depends on appropriate management
- Minimizing degradation or desertification

Rangeland Soil Management

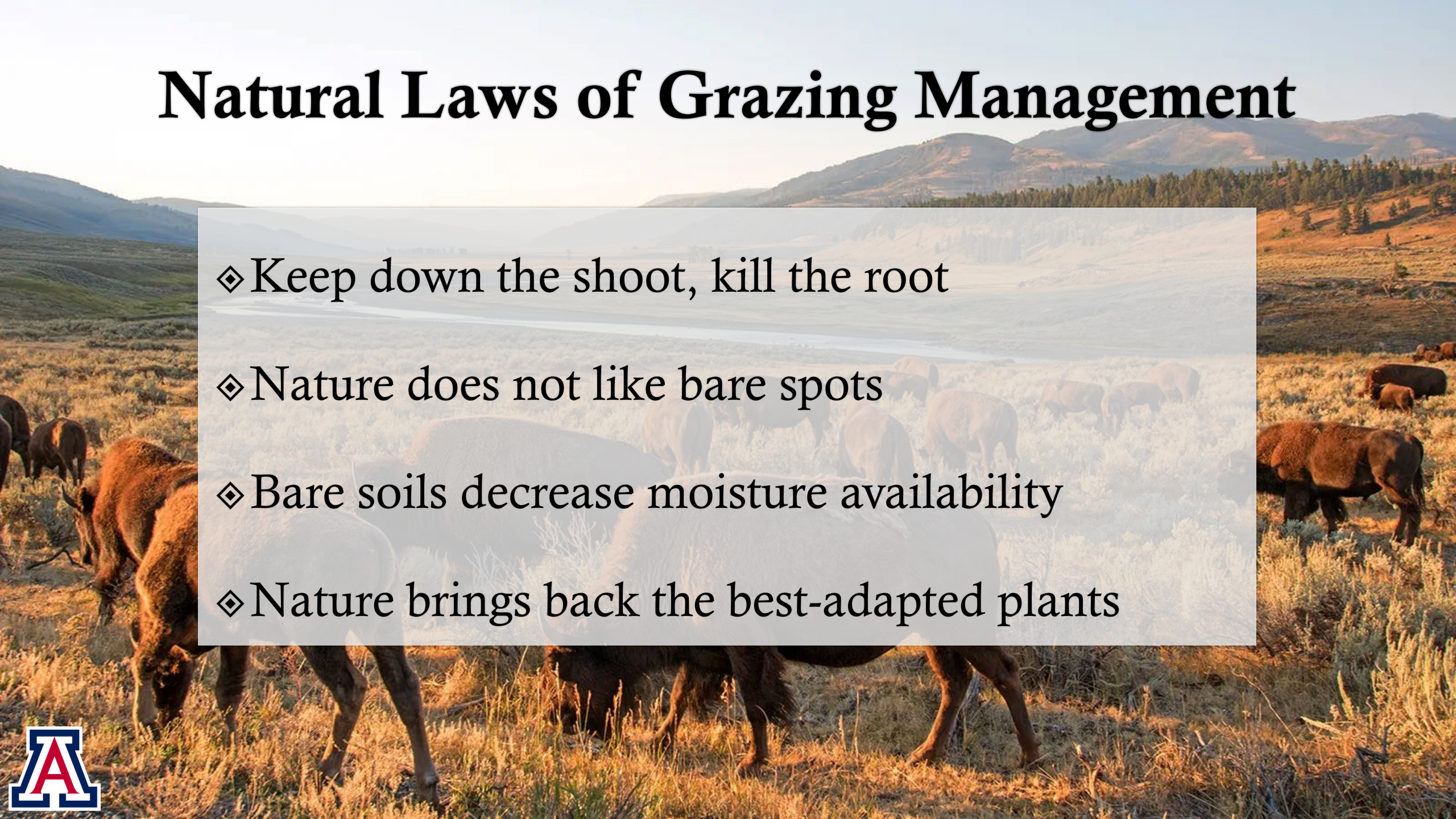
- Sequester carbon
- Reverse soil carbon loss
- Regenerate Soil Health
- Sink for greenhouse gases



Grazing and Soil Health: What we know

- Grazing increases soil compaction relative to no grazing
- Rotational grazing reduces compaction and increases soil carbon
- Rotational grazing could create climate change mitigation
- Reduced grazing intensity reduces compaction and increases C
- Soil texture and annual precipitation moderate grazing impacts

Natural Laws of Grazing Management



- Keep down the shoot, kill the root
- Nature does not like bare spots
- Bare soils decrease moisture availability
- Nature brings back the best-adapted plants

Keys to Grazing Management

- Stocking rate
- Livestock rotation
- Utilization rate/ Grazing intensity
- Plant rest and recovery

Rangeland Seeding

- Alter rangeland **vegetation**
- Provide better **quality forage**
- **Seasonal balance** of quality forage
- Impart **biodiversity**
- Soil stability/water and carbon storage

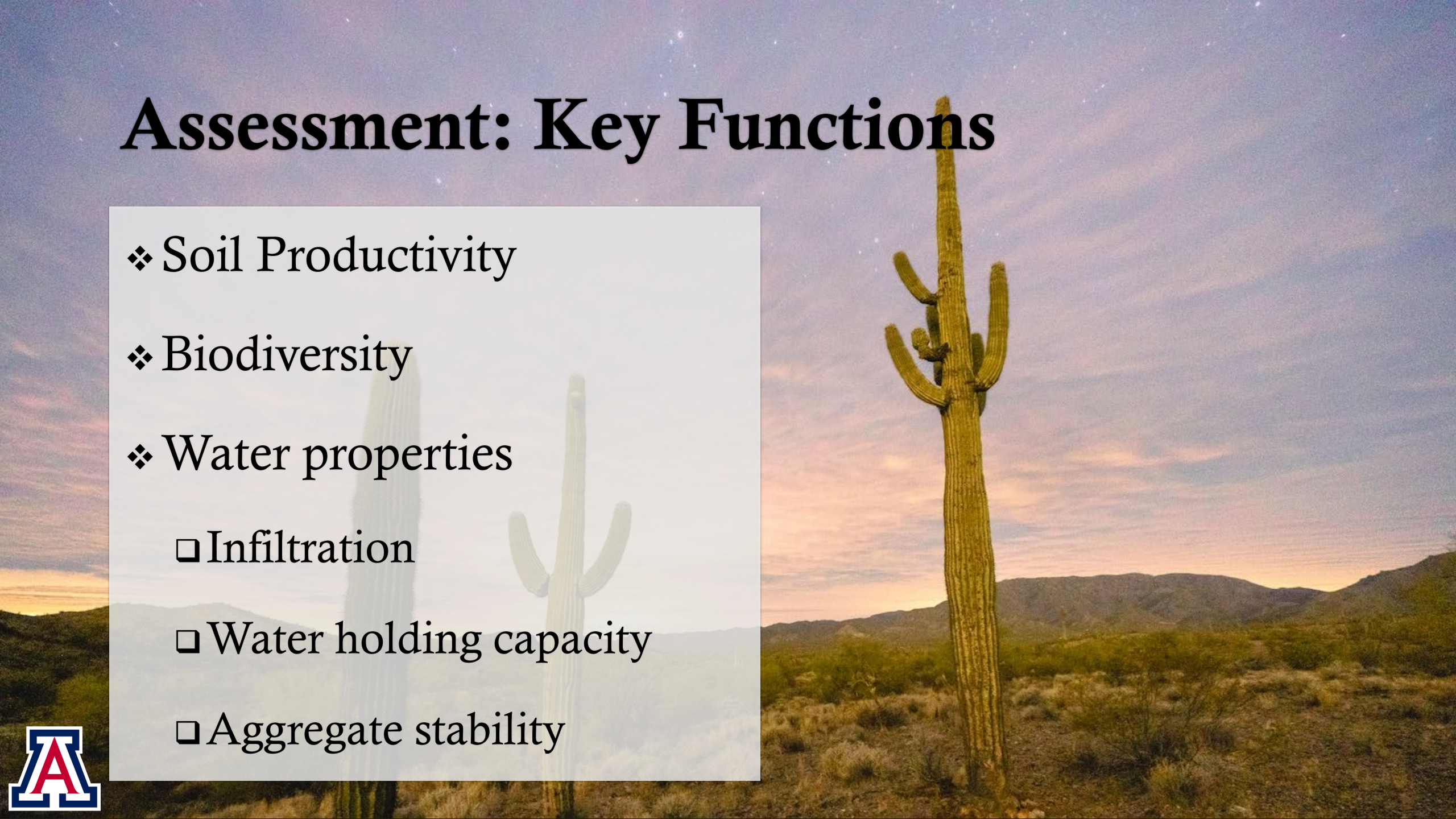
Rangeland Soil Health Indicators

Soil health principle	Qualitative rangeland assessment indicator
Increase plant diversity	Indicator 10–Plant community composition and distribution relative to infiltration and runoff
	Indicator 12–Functional/structural groups
	Indicator 13–Amount of plant mortality and decadence
	Indicator 15–Annual production
	Indicator 16–Invasive plants
Reduce soil disturbance	Indicator 9–Soil surface loss or degradation
	Indicator 8–Soil surface resistance to erosion
	Indicator 11–Compaction layer
Extend period of active plant growth	Indicator 4–Bare ground
	Indicator 12–Functional/structural groups
	Indicator 15–Annual production
	Indicator 16–Invasive plants
Maintain soil cover	Indicator 4–Bare ground
	Indicator 14–Litter amount

Printz et al. 2014

Assessment: Key Functions

- Soil Productivity
- Biodiversity
- Water properties
  - Infiltration
  - Water holding capacity
  - Aggregate stability



Levels of Soil Health Assessment

- Level 1 – Observations:
  - Amount of bare soil present, surface horizon depth, signs of erosion, soil structure and aggregation, soil texture, penetration resistance, salt accumulation and moisture content
- Level 2 - Field Tests:
  - Bulk density, ponded infiltration, aggregate stability, soil pH, soil electroconductivity (EC), lime content, and plant-available nitrogen and phosphorus.
- Level 3 – Lab Tests:
  - Soil health indicators such as soil organic matter (SOM) and carbon, plant available nutrients, active carbon, biologically available nitrogen, and soil salinity and sodicity

Key Research Questions

- Evaluating the **effects of conservation practices** on soil health
- Identifying the "**early indicators**" of soil health changes
- Adopting management practices integrating **climate resiliency**
- How to **monitor** soil health

Thank you!

Please feel free to contact me at:
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