USDA-Agricultural Research Service: Soil health efforts on grazinglands

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USDA United States Department of Agriculture

Agricultural Research Service

Road Map

- **Grazingland characteristics**
  - **Rangeland vs. pastures**
- **What we know:**
  - **Environmental controls**
  - **Management**
  - **Genetics x Environment x Management (G x E x M)**
- **What we don’t know:**
  - **Where does the thermometer go?**

Importance of Grazinglands

- >50% of earth's land area
- Contains 10-30% of global soil organic carbon (SOC)
  - Improper management can release this back to atmosphere
  - Carbon sequestration rates are low on rangelands but large land area
- Ecosystem co-benefits
  - Greater soil water holding capacity
  - Improved soil structure
  - Enhanced nutrient cycling
  - Reduced soil erosion
  - Habitat improvements

Rangelands vs. Pastures

- **Rangelands**
  - Native species (mix of C3/C4)
  - Low inputs (if any)
  - Extensive rotational grazing management
  - High degree of spatiotemporal variability in soils, topography, climatic conditions/weather, plant communities, seasonal precipitation distribution

- **Pastures**
  - Improved species
  - Water, fertilizer and chemical inputs
  - Intensive grazing management
  - Capacity for increased soil C due to prior management and inputs

What We Know: Environmental Controls

- Soil C sequestration characterized by short periods (2-3 months) of high C uptake and long periods of C balance or small losses
- Lag effect following drought where flush of accumulated soil N is incorporated into biomass
- Clay and loamy soils have more soil C capacity than sandy soils

Summary of Different Grazinglands

Location	Vegetation	Mean (and range) annual net ecosystem exchange (g C/m^2/yr)
Las Cruces, NM	Desert grassland	-160 (-254 to 94)
Lucky Hills, AZ	Desert shrub	-93 (-162 to 55)
Burns, OR	Sagebrush steppe	73 (-61 to 229)
Dubois, ID	Sagebrush steppe	83 (-47 to 260)
Mandan, ND	Northern mixed prairie	53 (-27 to 119)
Nunn, CO	Shortgrass steppe	107 (4 to 227)

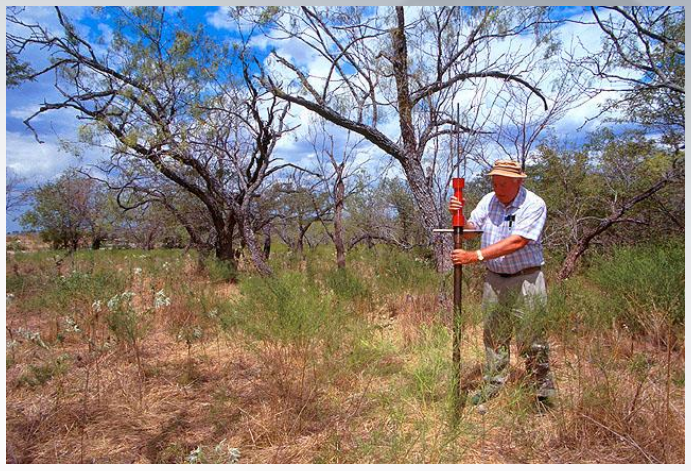
Svejcar et al. 2008

What We Know: Management Controls

- Soil bulk density increases with stocking rate
- Grazing increases soil C compared to non-grazing
- Light to moderate grazing enhances soil C
- Heavy grazing: C gains in wet years and large losses in dry years/seasons
- Adding legumes has large potential for soil health

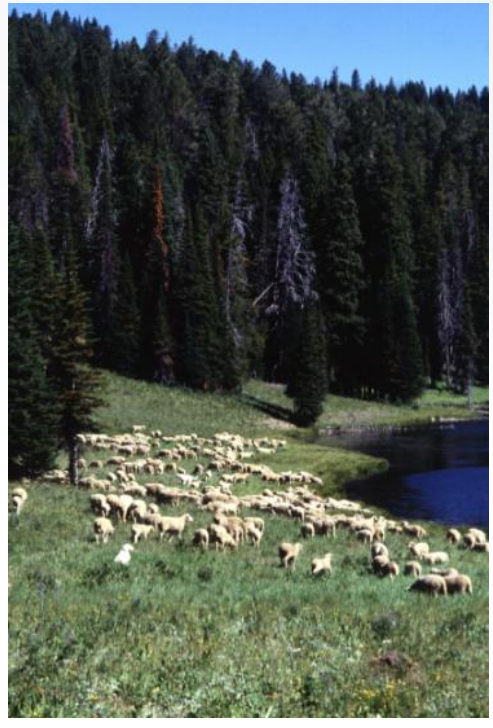
Management to Increase Soil C

- **Stimulate C cycling**
  - **Aboveground plant litter to soil**
- **Stimulate aboveground production**
  - **Alter vegetation composition**
  - **Adding legumes for N**
- **Alter above:below ground C allocation**
  - **Shift allocation more belowground**



What We Know: Genetics x Environment x Management

- Prediction of benefits of soil health difficult due to variability in soils, ecosystems, climate and management across large geographic areas
- Soil C dynamics related to precipitation trends
- Soil C dynamics greatest with heavy grazing
- Short-term soil respiration is a good indicator of soil biological activity and nitrogen cycling
- Little known about adaptive management and soil C for application to rangelands



What We Do Not Know

- **Soil health research lacking for rangelands**
  - **Lots of efforts on croplands, but not directly applicable**
- **Where does the thermometer go?**
  - **What do we "measure" for soil health?**
  - **Do we focus on structural, chemical or biological components of soil health?**
  - **What are the key "tests" for soil health?**
- **With prior proper management, is there capacity for *improving* soil health?**

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Questions?