



# Carbon Sequestration

## Through Careful Rangeland Management

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# Midland School

- Central California – Los Olivos
- A boarding school founded in 1932
- Oak Savanna
- Average rainfall: 17 inches / year
- Loamy soil with an average root depth of 60 inches
- Grazing area encompasses 2,832 acres

# Objectives

- Successfully incorporate rotational grazing on Midland's 28-acre pasture
- Increase root exudates, sloughing of roots, and humus
- Increase carbon sequestration
- Implement rotational grazing on full-scale level to three other 600 acre pastures

# Grazing Techniques

- CONTINUOUS / SEASON LONG STOCKING: animals are free to graze without restrictions
- DEFERRED STOCKING: not allowing certain areas of land to be grazed so it is able to recover
- ROTATIONAL STOCKING: animals move periodically, allowing adequate recovery time (the most management intensive)

# Rotational Grazing Procedure

-100 cows grazing 1 acre for 1 day

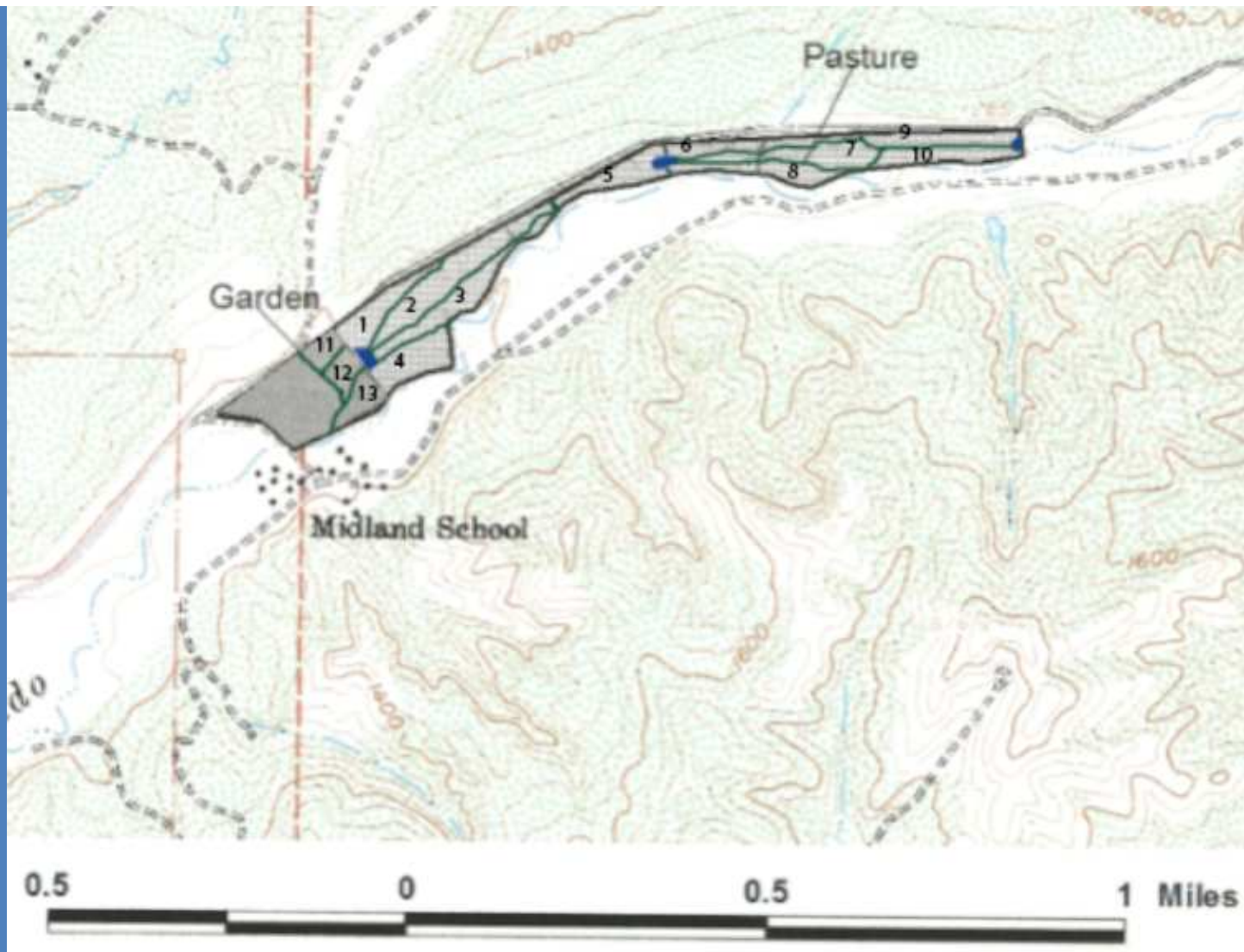
-1 cow grazing 1 acre for 100 days

The more cells: the more recovery time

- Cells viable
- Stocking density
  - Number of animals / acres
- Duration
  - Days spent each cell

## CONCERNS

- .Water access
- .Animal Days (amount an animal eats in one day)
- .Slow growth vs. rapid growth
  - overgrazing
  - plants reach maturity



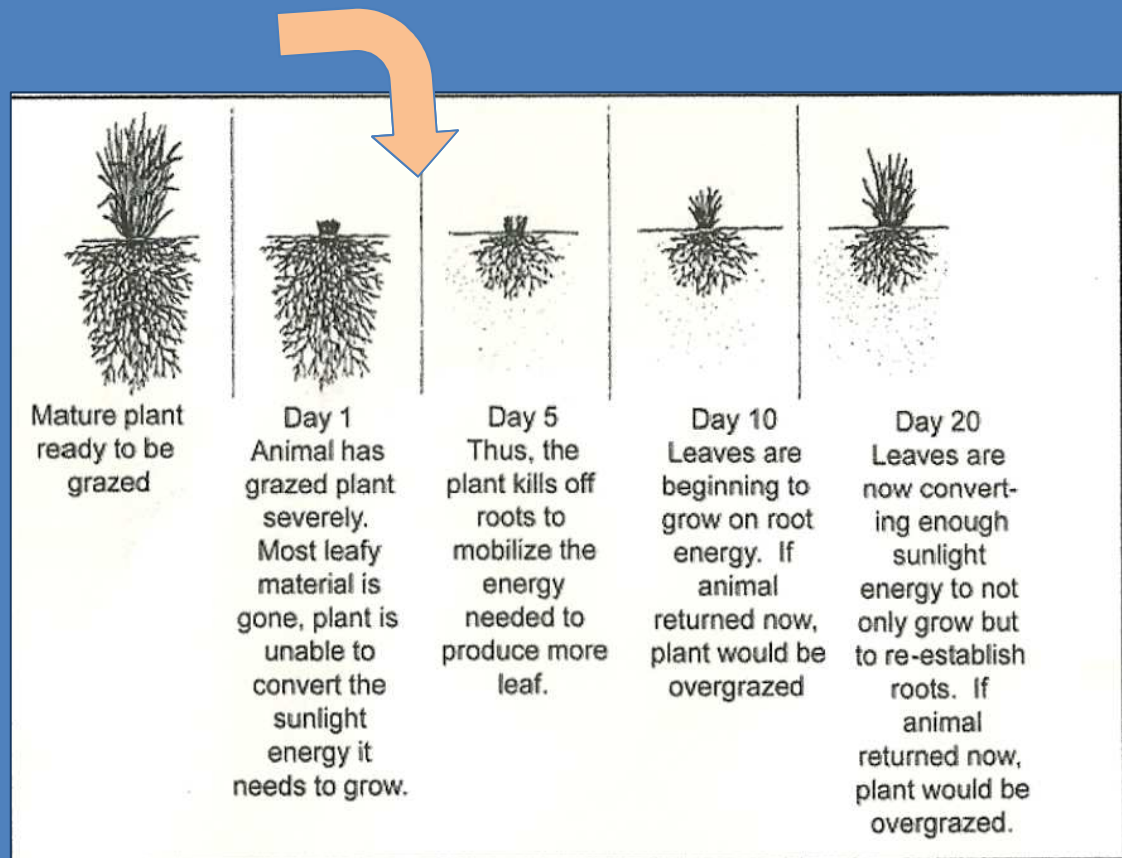
- Allotting 7 day grazing period in each cell
- Therefore cells receive an 84 day recovery period total

# A Sampling of Literature

- In Shasta County the Energy Commission of California conducted a pilot study and discovered that sites with low soil carbon were able to hold more carbon after high intensity grazing was introduced (Franco et. al, 2007).
- In the West African Sahel Region, rotational grazing was practiced for 50 years and carbon sequestration showed an increase of 4-5% greater than the initial storage. (Badini et al, 2007).
- The Marin Carbon Project teamed up with Whendee Silver of UC Berkeley in an attempt to better understand greenhouse gas patterns. It was discovered that carbon pools are greatest near woody plants and rotational grazing and adding compost increase carbon pools (Silver et al, 2009).

# Carbon Sequestration

- Sloughing of Roots: After the leaves have been bitten off, the plant can no longer provide energy to sustain its whole root system



# Carbon Sequestration

- Root Exudates: In photosynthesis, plants produce a surplus of glucose to exchange with mycorrhizae

$6\text{H}_2\text{O}$  (water) +  $6\text{CO}_2$  (carbon dioxide)

--Sunlight-->  $\text{C}_6\text{H}_{12}\text{O}_6$  (glucose) +  $6\text{O}_2$  (oxygen)

-Perennial Plants have deep root systems which place carbon deep underground

.*Leymus triticoides* (Creeping Wild Rye)

.*Nasella pulchra* (Purple Needle Grass )

# Carbon Sequestration

- Humus: Organic matter that has been digested by soil organisms and turned into a stable form.  
-dark color, colloidal, 50% carbon
- Increase by producing lots of plant material and by permitting it to decompose at a leisurely rate

The hooves of the animals incorporate the plant litter into the soil

# Summary

- Restoring rotational grazing
- Extends growing season > sloughing of roots
- Even level grazing > perennials > deeper root system
- High intensity > humus
- Incredible potential to mitigate climate change

# Midland's Future

- With the introduction of carbon markets on the rise, it's an extremely exciting time to be apart of this project.
- We are excited to pursue this project and truly evaluate for ourselves if these postulates are truly viable.
- Implement rotational grazing with other 600-acre pastures

# References

- Badini, Oumarou, Claudio O. Stöckle, Jim W. Jones, Roger Nelson, Amadou Kodio, and Moussa Keita. *A simulation-based analysis of productivity and soil carbon in response to time-controlled rotational grazing in the West African Sahel region*. Rep. Science Direct, 2007. Print.
- Butterfield, Jody, Sam Bingham, and Allan Savory. *Holistic Management Handbook Healthy Land, Healthy Profits*. New York: Island, 2006. Print.
- Franco, Guido. *Assessing Impacts of Rangeland Management and Reforestation of Rangelands on Greenhouse Gas Emissions: A Pilot Study for Shasta County*. Rep. PIER Energy-Related Environmental Research, 2007. Print.
- Gadzia, Kirk, and Nathan Sayre. *Rangeland Health and Planned Grazing Field*. New Mexico: The Quivira Coalition and Earth Works Institute, 2007. Print.
- Kohnke, Helmut. *Soil science simplified*. Prospect Heights, Ill: Waveland, 1995. Print.
- Kothmann, Mort. "Grazing Methods: A Viewpoint." *Society for Range Management* (2009): 5-10. Print.
- Pratt, David W. *Pasture Ecology*. Rep. California Grazing Academy, 1994. Print.
- Sage Associates, comp. *Midland School Cattle Grazing Plan*. Rep. no. Plan. Montecito: Sage Associates, CA. Print.
- Savory, Allan, and Jody Butterfield. *Holistic Management A New Framework for Decision Making*. New York: Island, 1998. Print.
- Silver, Whendee L., and Rebecca Ryals. "Soil Carbon Sequestration: A Low-Cost, High-Benefit Approach to Climate Change Mitigation." Lecture. California Climate Change Research Symposium, 2009. Web.
- *USING LIVESTOCK GRAZING AS A RESOURCE MANAGEMENT TOOL IN CALIFORNIA*. Rep. Contra Costa: Contra Costa Water District, 2005. Print.
- Wick, John. *Marin Carbon Project | Home*. 2009. Web. 31 Jan. 2010.