Texas A&M AgriLife Research

Improving Life through Science and Technology

Planned Grazing to Improve Ecosystem Function and Ranch Livelihoods

Air Quality Meeting
College Station
20th August 2014

Richard Teague,
Texas A&M AgriLife Research, Vernon

Overview

- Need to improve ecosystem function
- Need for more applicable research
- Managing *adaptively* for desirable results
- Testing a ranch scale hypothesis
- Published research results
- Conclusions
- Importance for climate change mitigation

Improving Rangeland Ecosystem Function

- Healthy agro-ecosystems are considerably more productive, stable and resilient than those in poor condition.
- Ranch livelihoods depend on healthy ecosystems
- The value of ecosystem services to society is worth more to society than agricultural earnings.

My Goal

Find out :

- Why there is a discrepancy between some research and rancher achievements

- What is the best that management can achieve to sustain:
  - livelihoods
  - delivery of ecosystem goods and services

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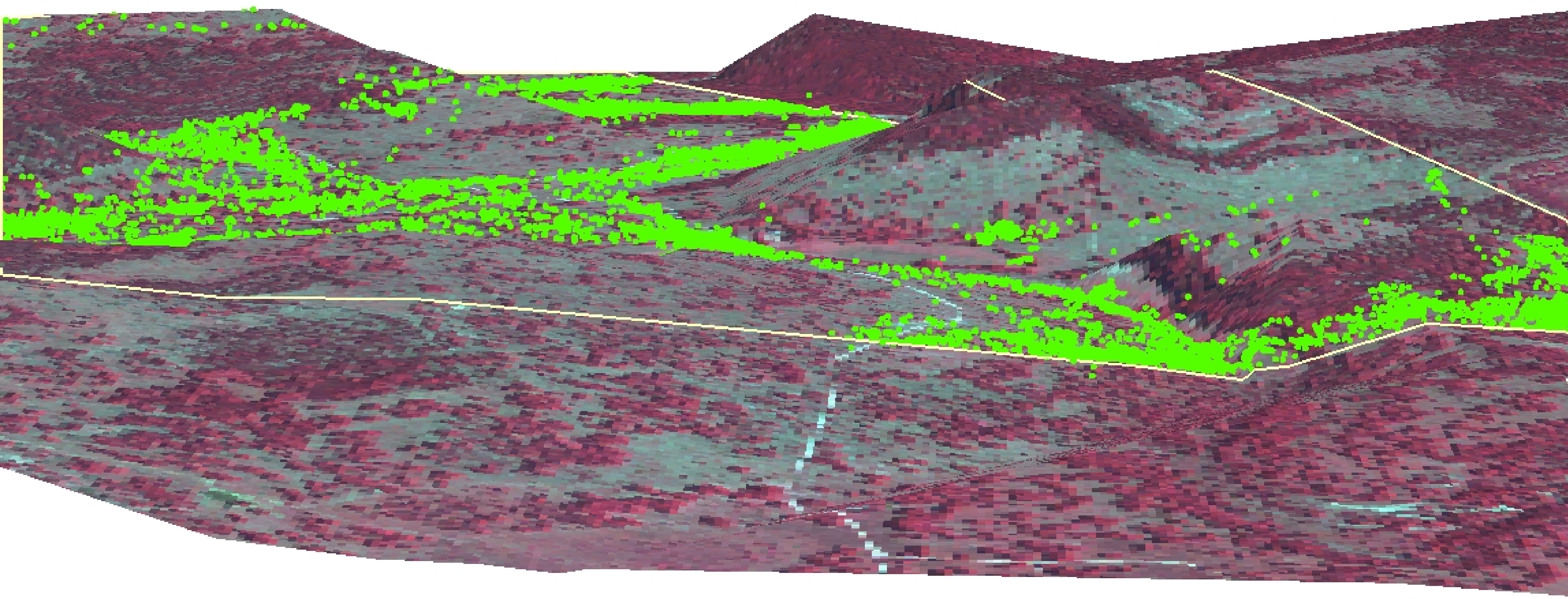
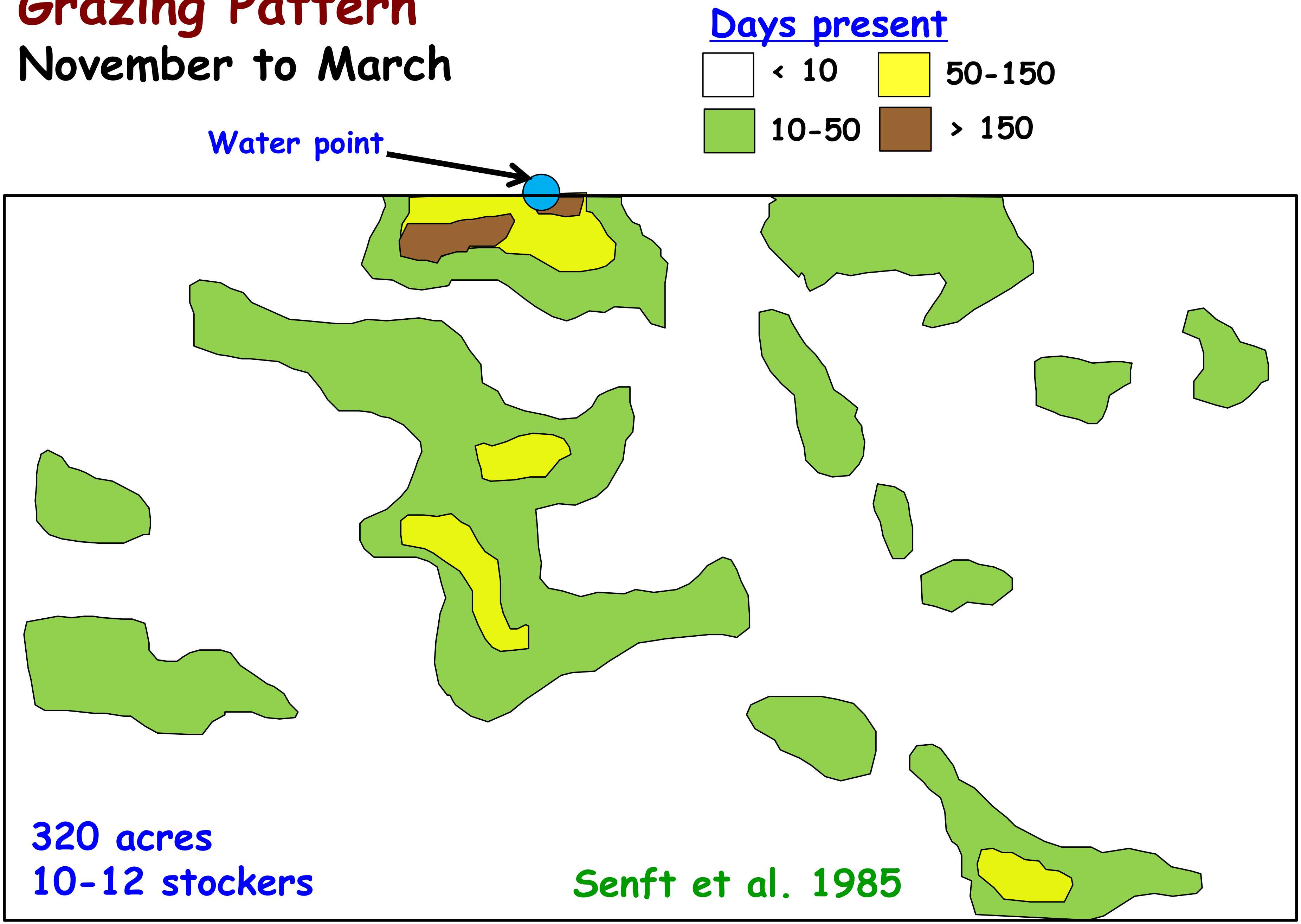
Edwards Plateau Ranch 3-D View w/ GPS Locations

1. 39% area used
2. 41% GPS points on 9% area
3. SR: 21 ac/cow
4. Effective SR: 9 ac/cow



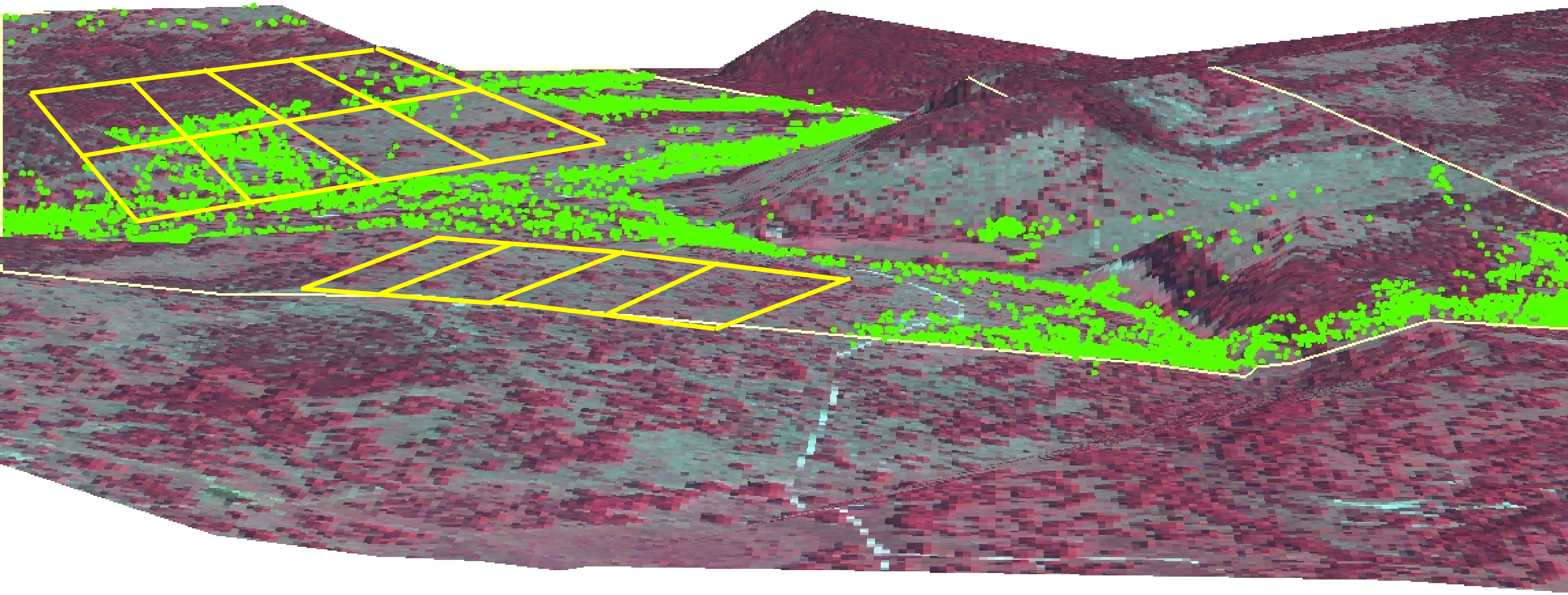
Grazing Pattern
November to March



320 acres
10-12 stockers

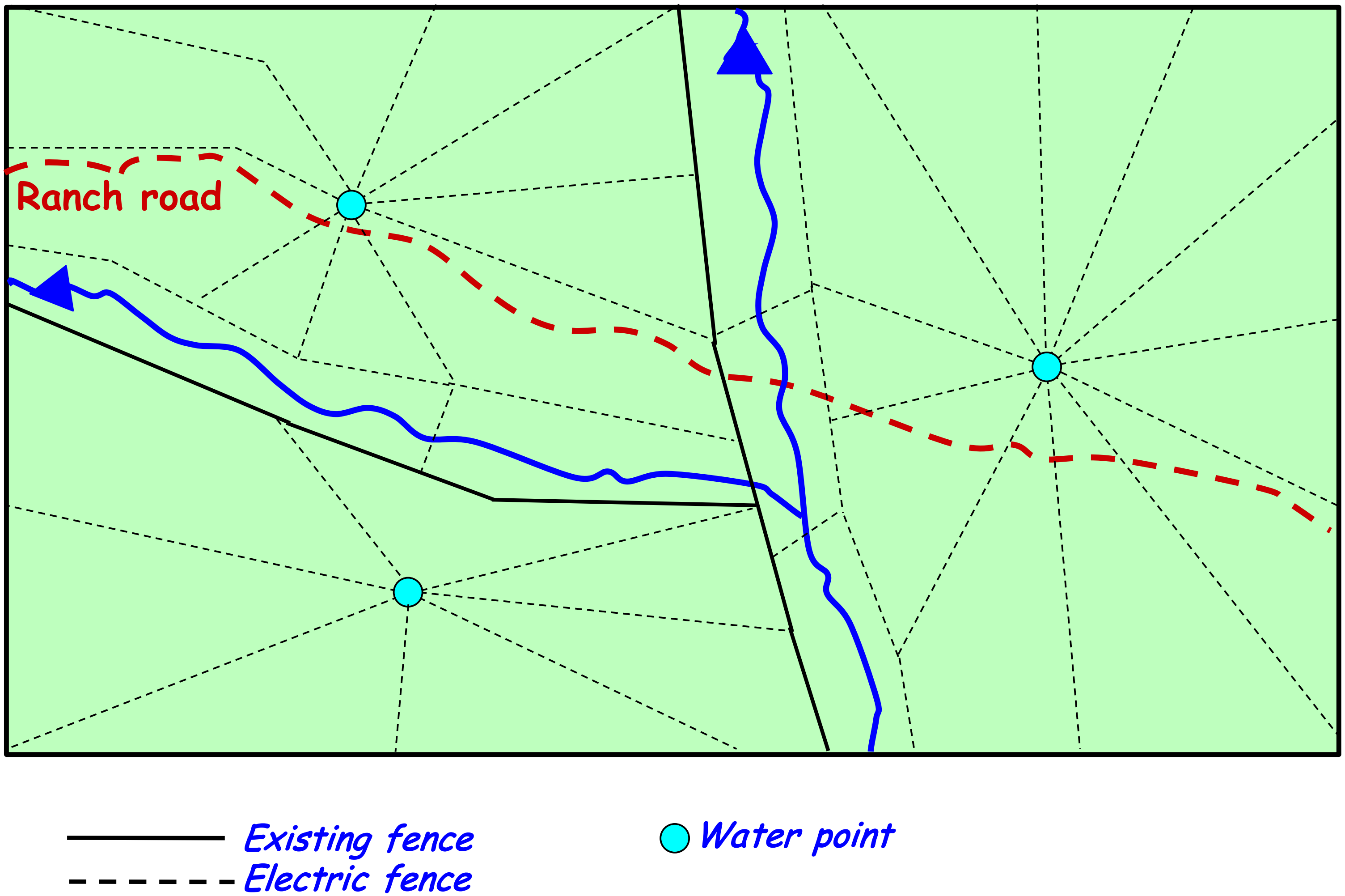
Senft et al. 1985

Previous research on multi-paddock grazing



Landscape impact of continuous grazing

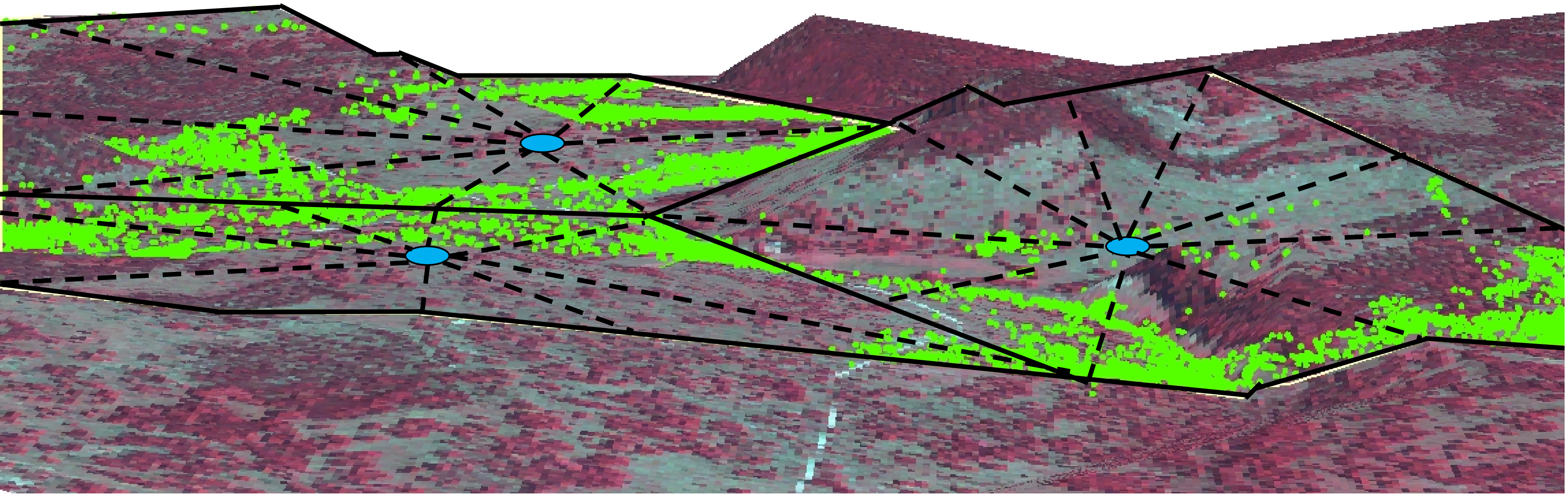
Planned multi-paddock grazing



Planned multi-paddock grazing

<u>Animals</u>:

- Graze more of the whole landscape
- Select a wider variety of plant species



<u>Manager can control</u>:

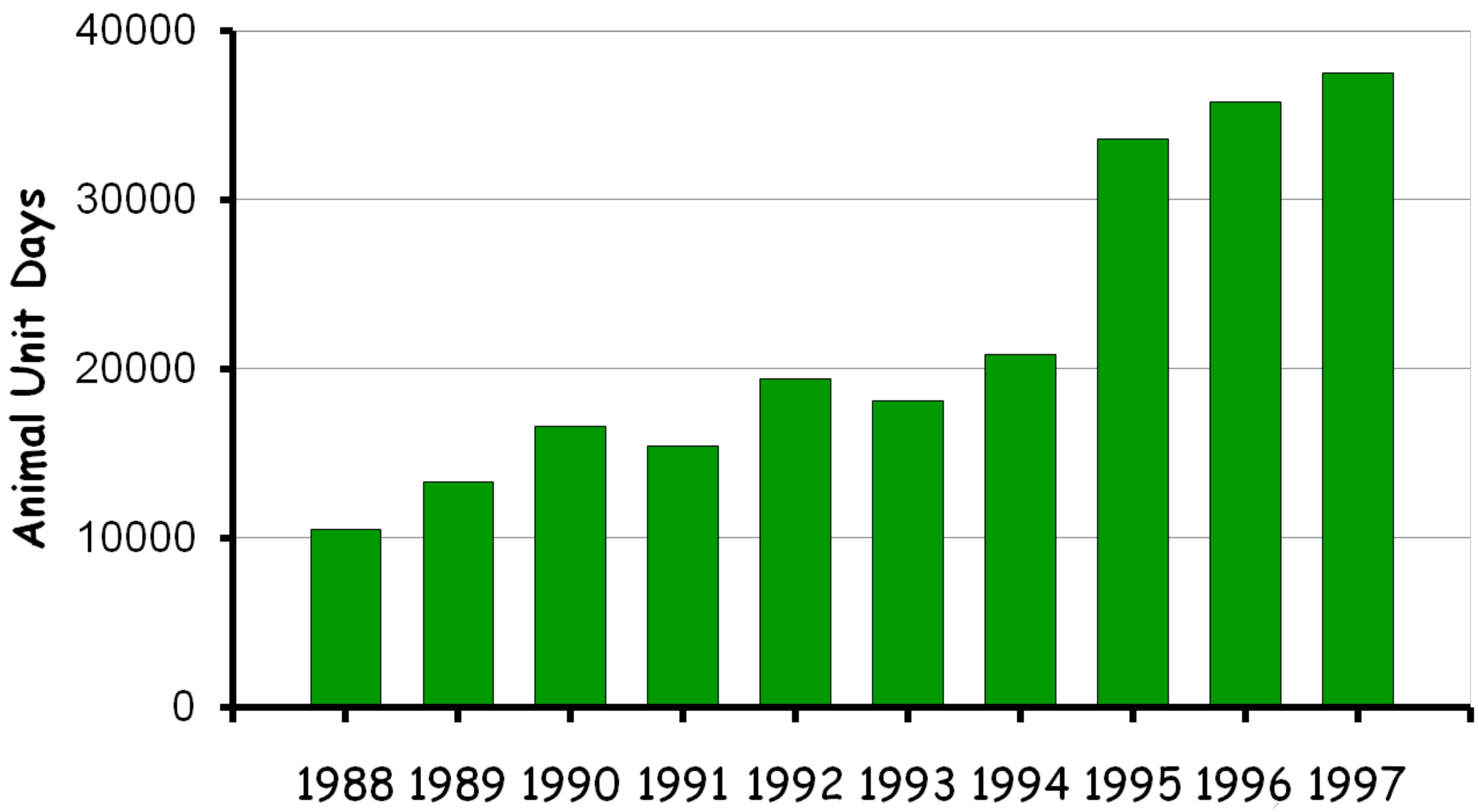
- How much is grazed
- The period of grazing, and
- The length and time of recovery

Restoration using multi-paddock grazing

Restoration using multi-paddock grazing

Noble Foundation, Coffey Ranch

Charles Griffith, Hugh Aljoe, Russell Stevens



Summary of Managing for Desired Outcomes

- Match animal numbers to available forage
- Spread grazing over whole ranch
- Defoliate moderately in growing season
- Short grazing periods
- Adequate recovery before regrazing
- Graze again before forage too mature
- Adaptively change these elements according to changing conditions

Teague et al. 2013

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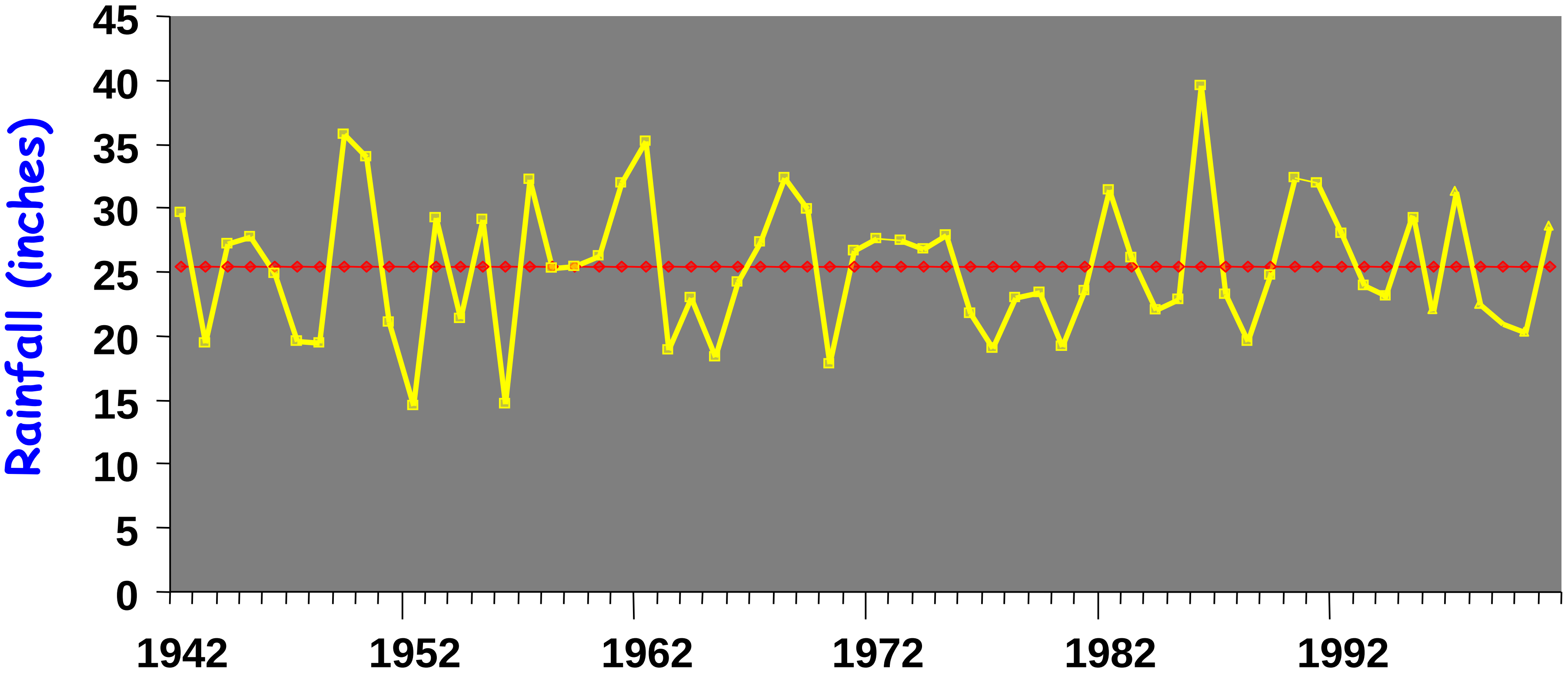
Mean annual precipitation



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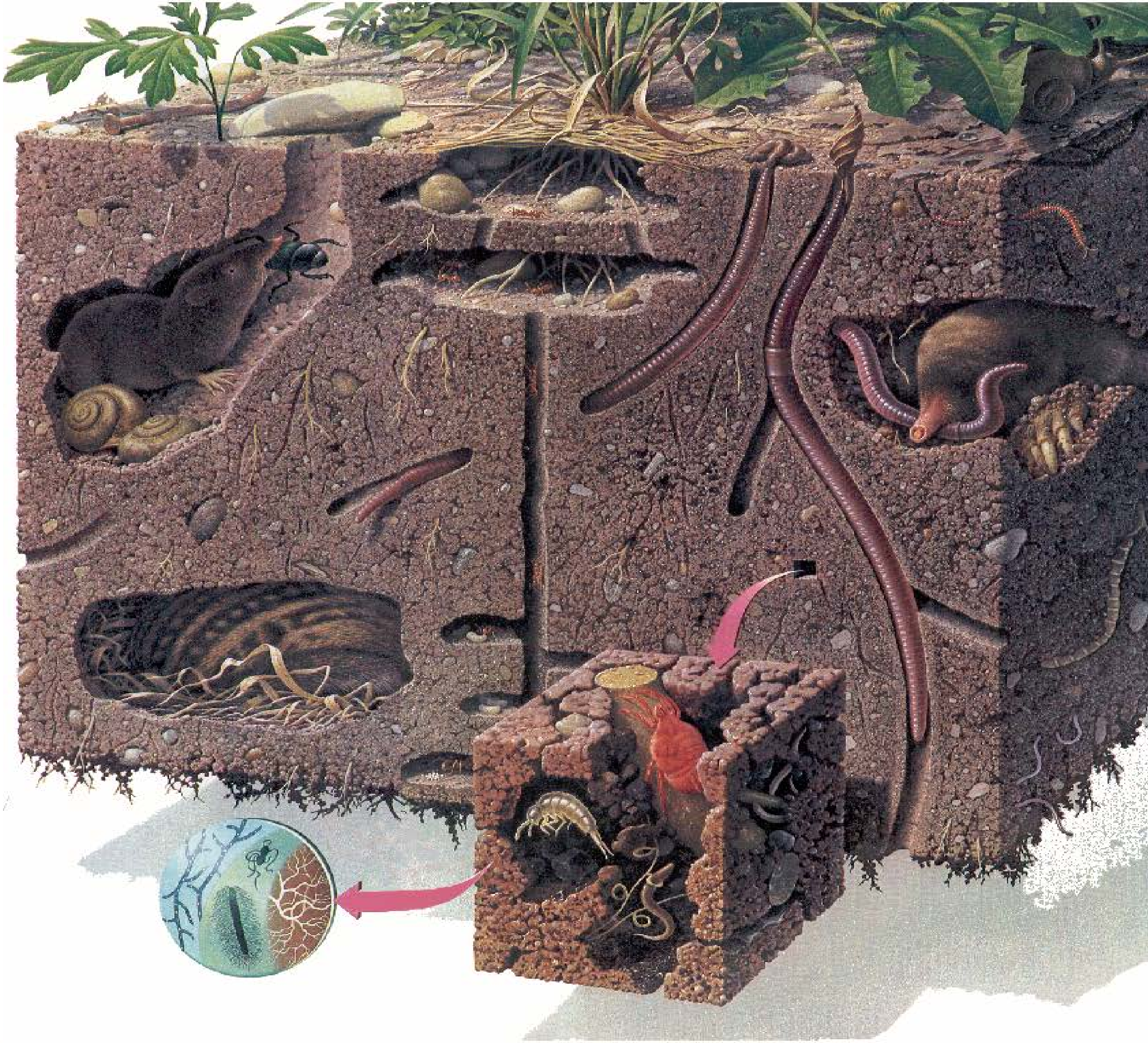
90% of Soil function is mediated by microbes

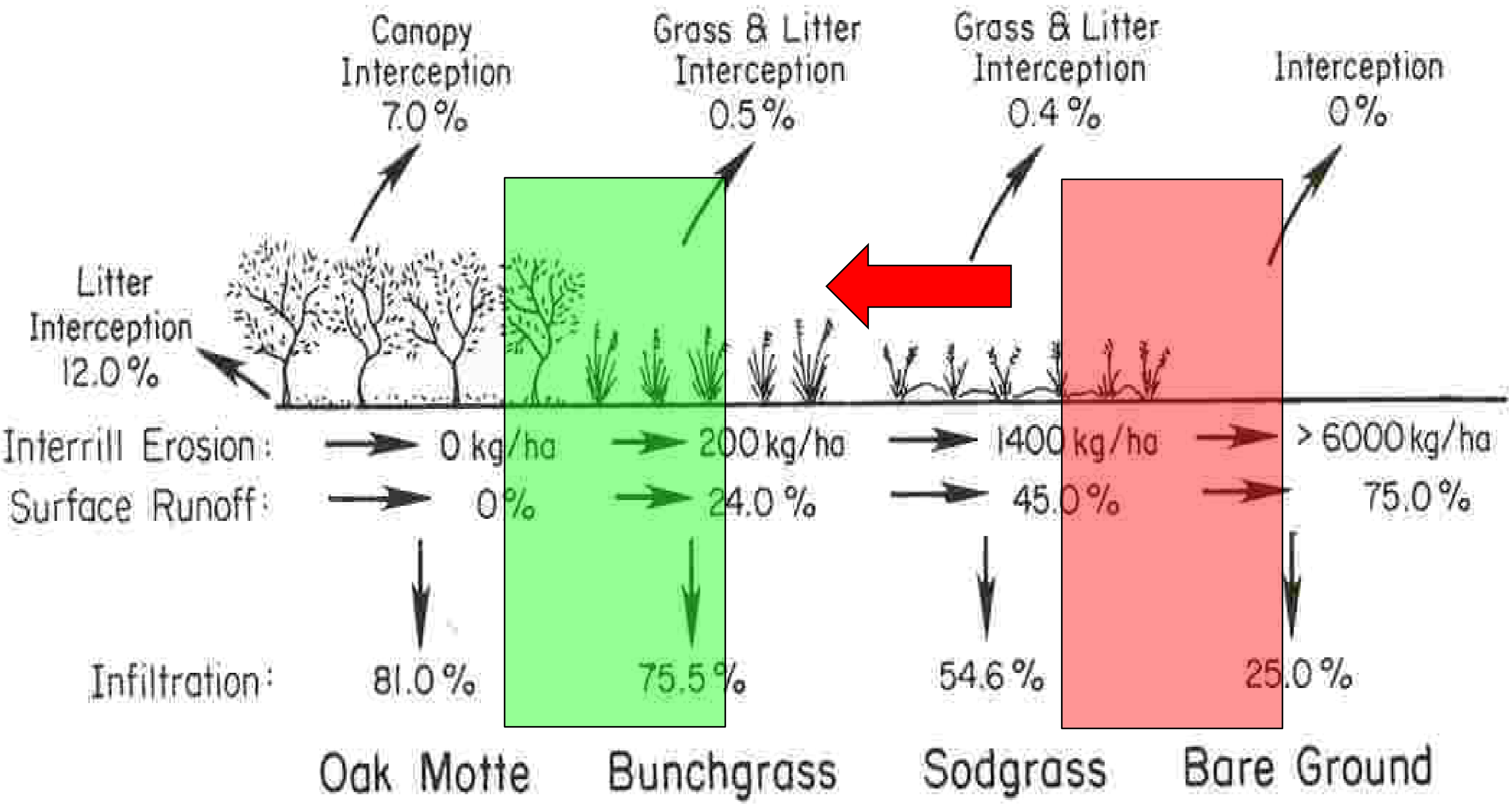
Microbes depend on plants

So how we manage plants is critical



Infiltration with Vegetation Composition

Thurow 1991



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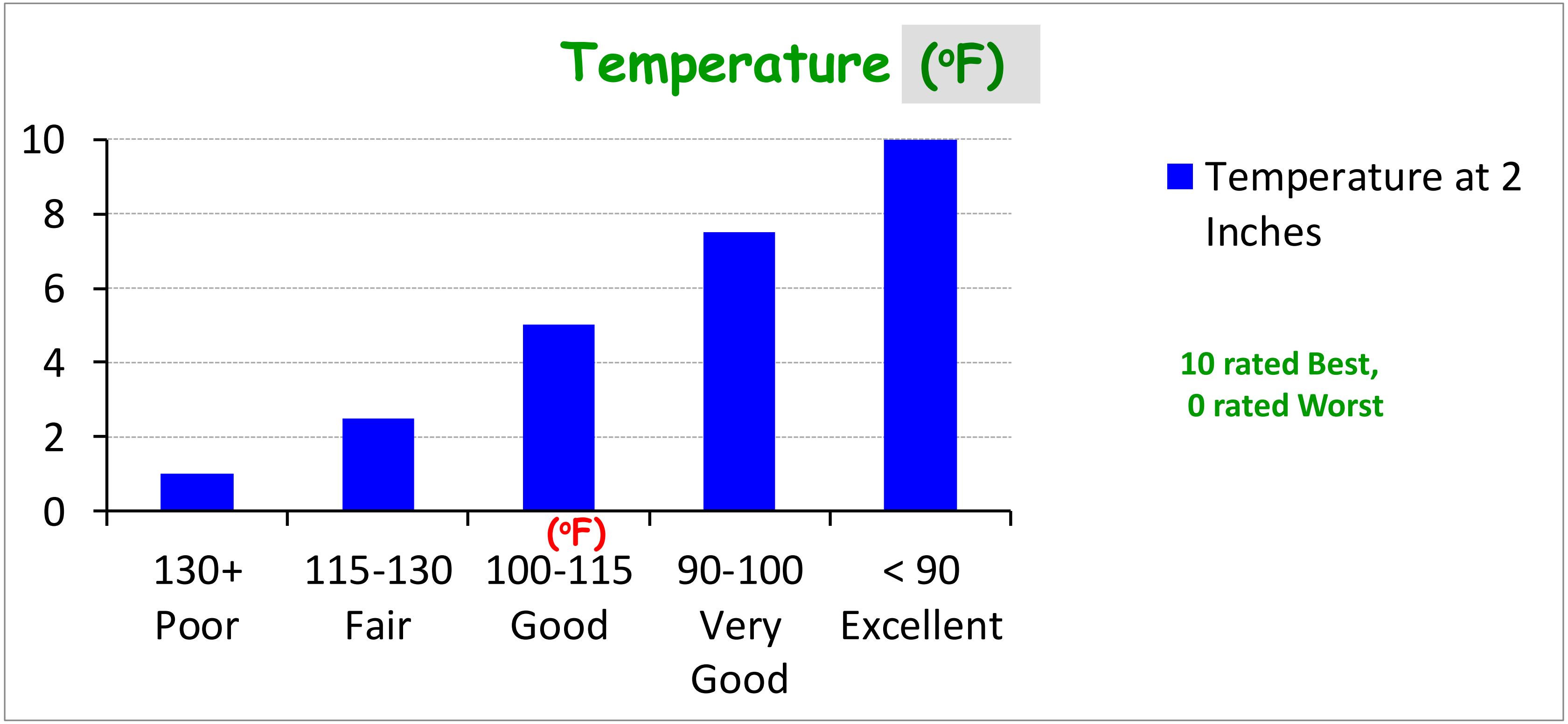
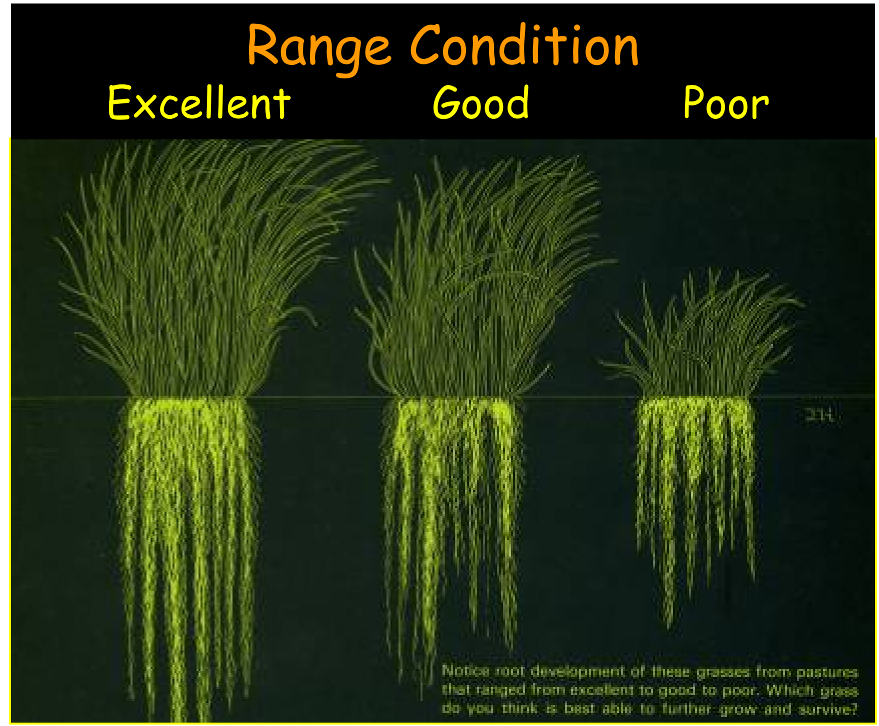
Indicator: Soil Temperature



1. At 70 °F, 100% of Soil moisture is used for growth.
2. At 100 °F, 85% of Soil moisture is lost and 15% is used for growth.
3. At 115 °F, microbes begin to breakdown, and
4. At 140 °F they die.

Decrease drought impacts

% Leaf Volume Removed	% Root Growth Stoppage
10%	0%
20%	0%
30%	0%
40%	0%
50%	2-4%
60%	50%
70%	78%
80%	100%
90%	100%



Continuous grazing at Light stocking

Over- and under-grazing side-by-side

Continuous grazing at Light stocking

Patch selection and overgrazing

Planned multi-paddock grazing

Richard's Ranch Jacksboro, TX

48 Paddocks grazed according to grass growth

When the grasses have been grazed once,


Cattle are moved to a fresh paddock.

Based on some published science and experience

Teague et al., 2013

What we need to know:

Understanding causal mechanisms is critical to knowing how to manage to regenerate from a degraded situation.

- What are the mechanisms causing degradation?
- What management reverses degradation?
- How good is Planned Multi-Paddock management as a restoration and management tool?
- Where does it work and not work?
- How does it need to be managed to make it work as well as it can?

Degradation Spiral

Decreased cover and SOC

↓

Deteriorated soil structure

↓

Decreased infiltration and water holding capacity

↓

Decreased cover and SOC

↓

We know what causes this at the small scale

Equilibrium of soil formation and soil erosion

How to manage for this at the ranch scale?

Regeneration Spiral

Increased cover and SOC

↑

Enhanced soil structure

↑

Enhanced infiltration and water holding capacity

↑

Increased cover and SOC

↑

Thurow 1991

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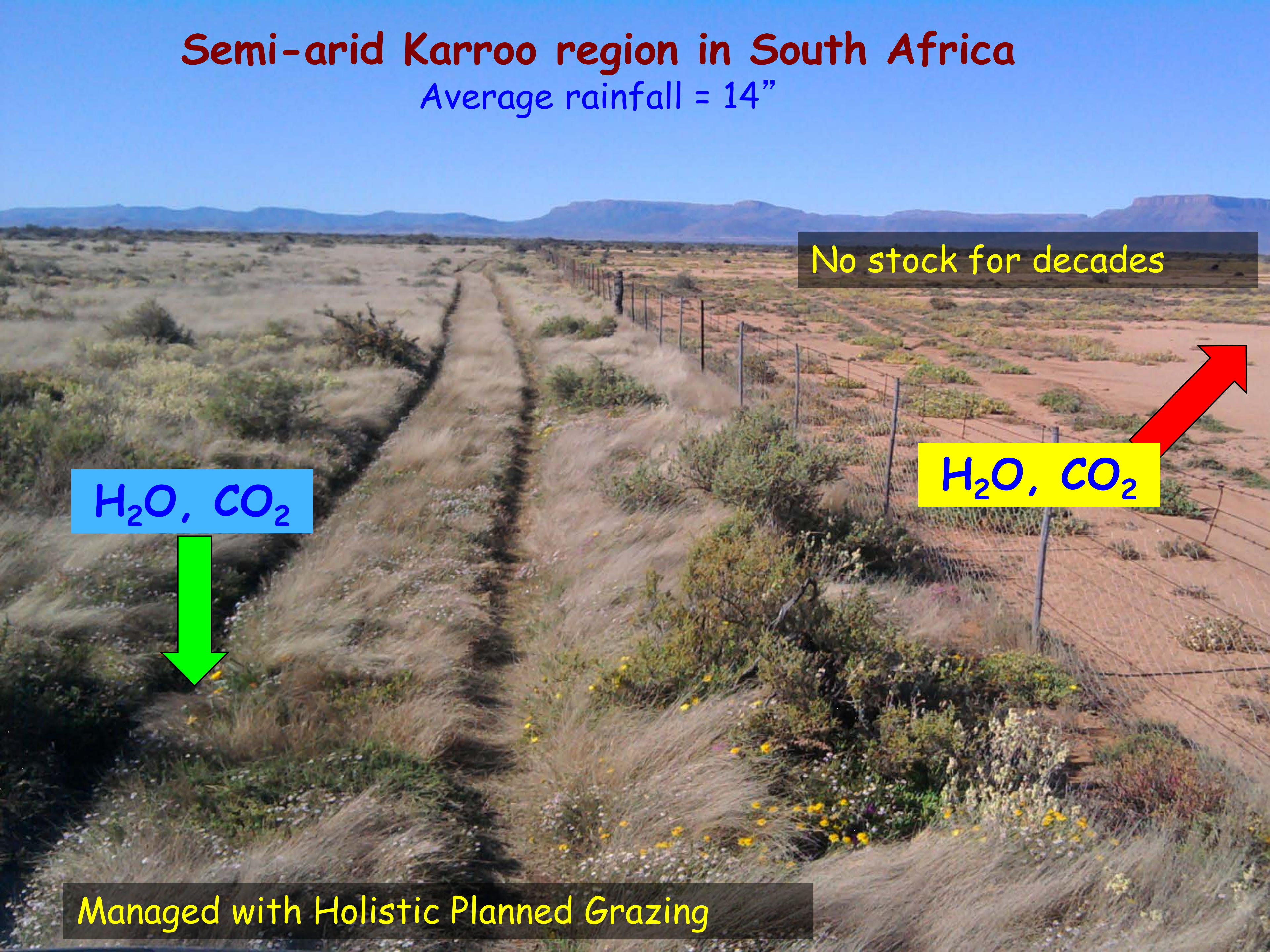

Semi-arid Karroo region in South Africa
Average rainfall = 14”
No stock for decades
H_2O, CO_2
H_2O, CO_2
Managed with Holistic Planned Grazing

An Alternate Ranch Scale Hypothesis

We propose and test the hypothesis that at the *commercial ranch scale*:

Planned multi-paddock grazing, *when adaptively managed* to give best vegetation and animal performance, has the potential to produce superior long-term:

1. Conservation and restoration of resources;
2. Ecosystem goods and services; and
3. Ranch profitability

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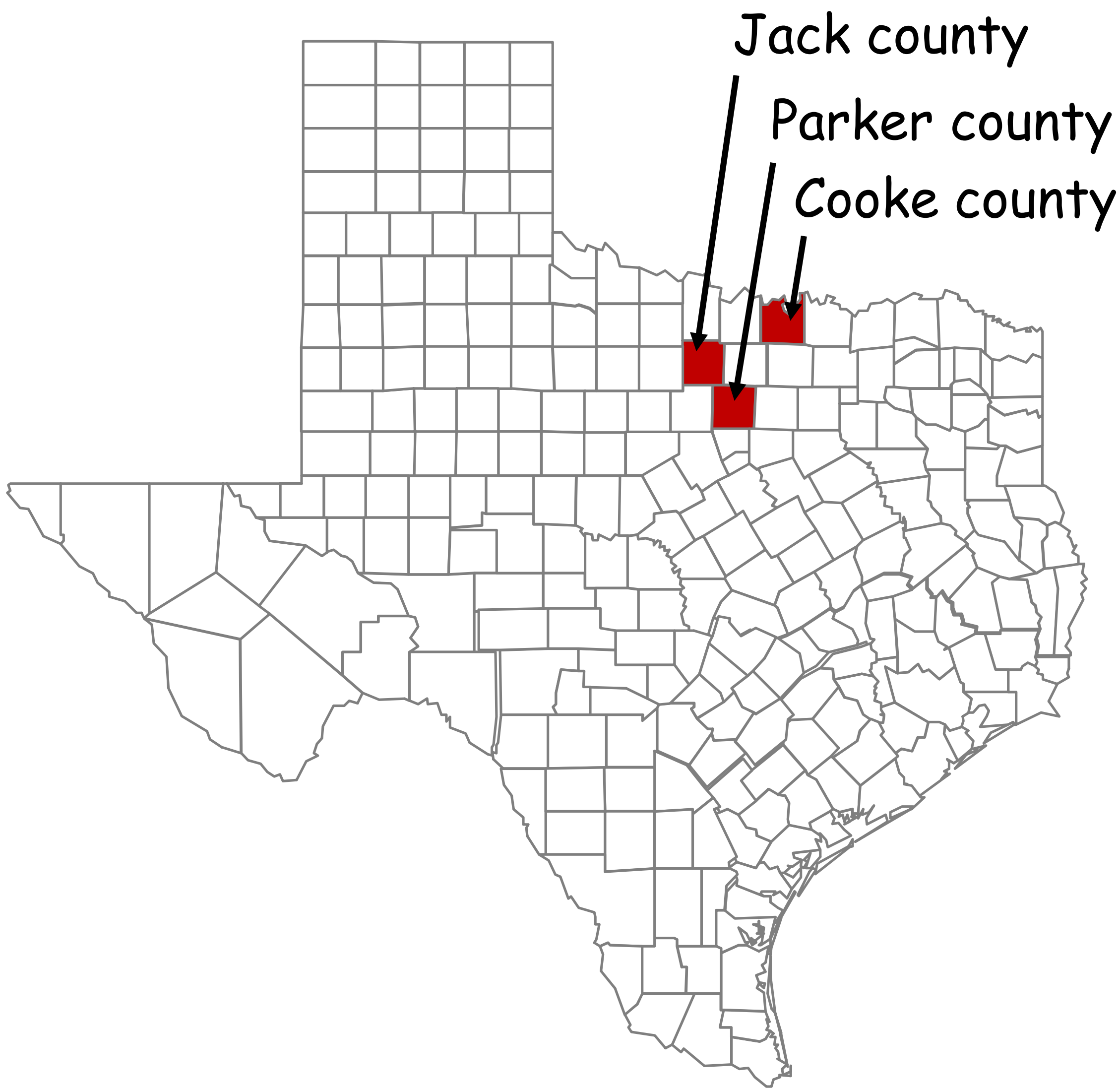
Influence of multi-paddock grazing on soil and vegetation



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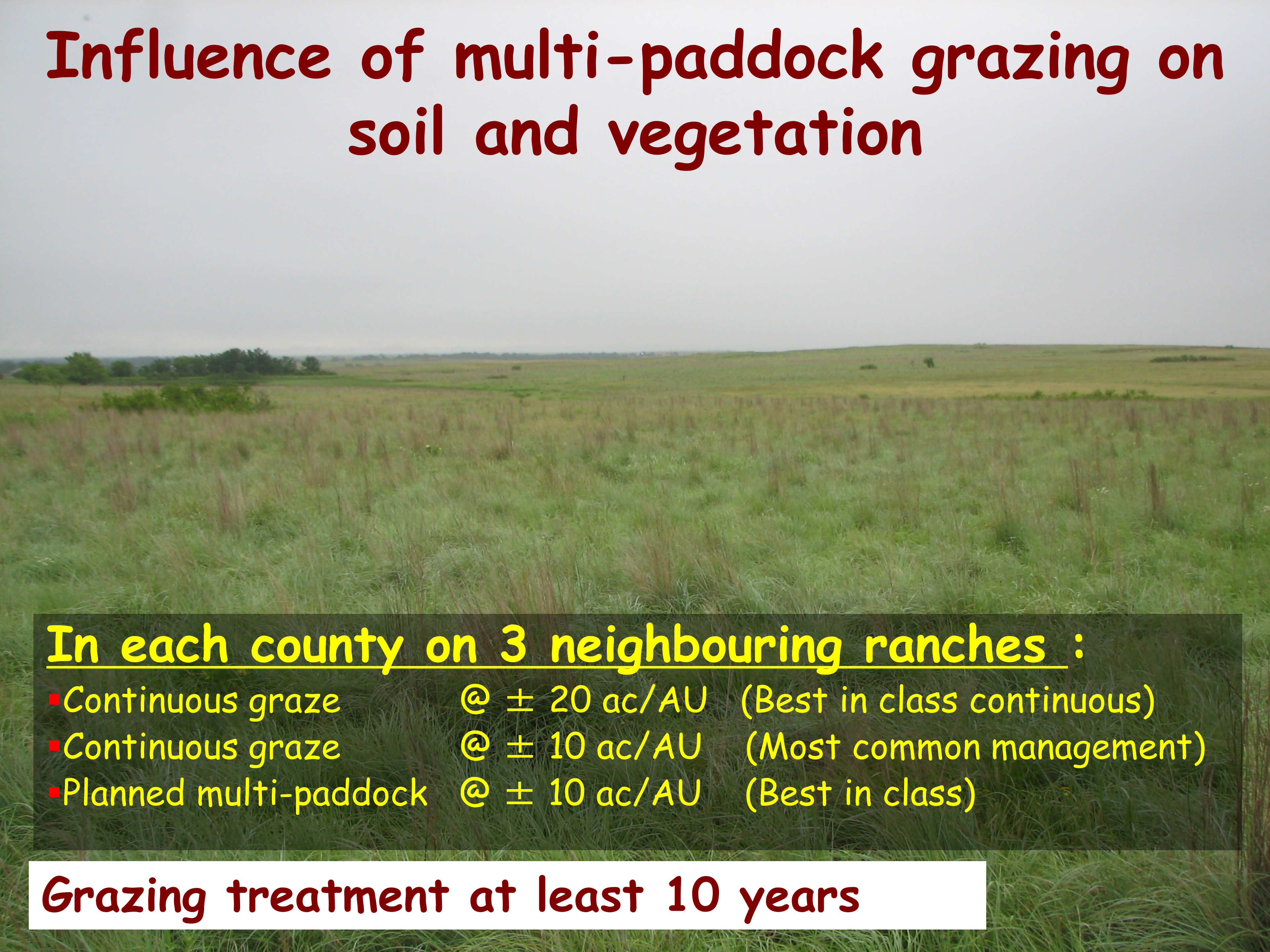
Influence of multi-paddock grazing on soil and vegetation

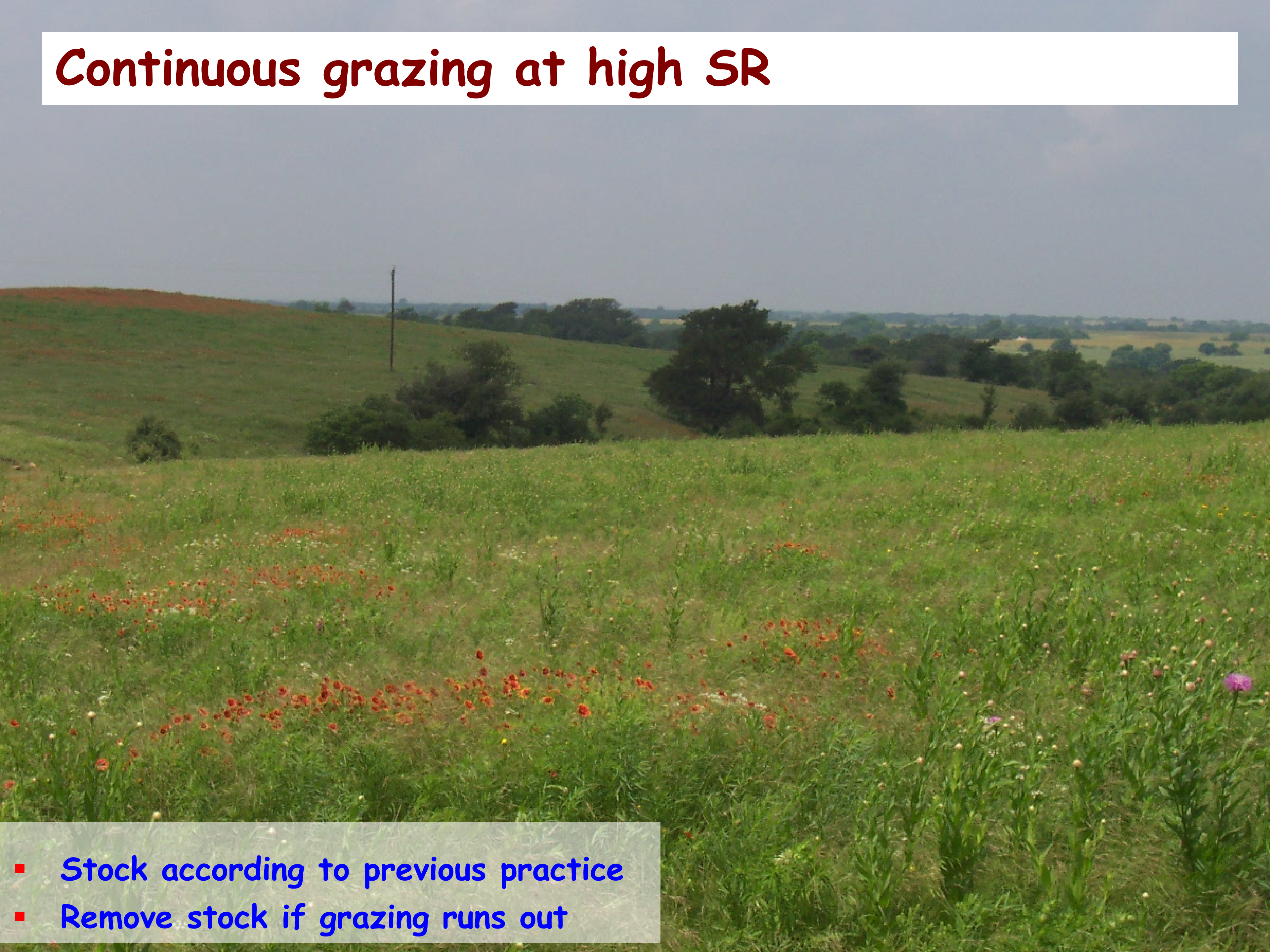


In each county on 3 neighbouring ranches :

- Continuous graze @ ± 20 ac/AU (Best in class continuous)
- Continuous graze @ ± 10 ac/AU (Most common management)
- Planned multi-paddock @ ± 10 ac/AU (Best in class)

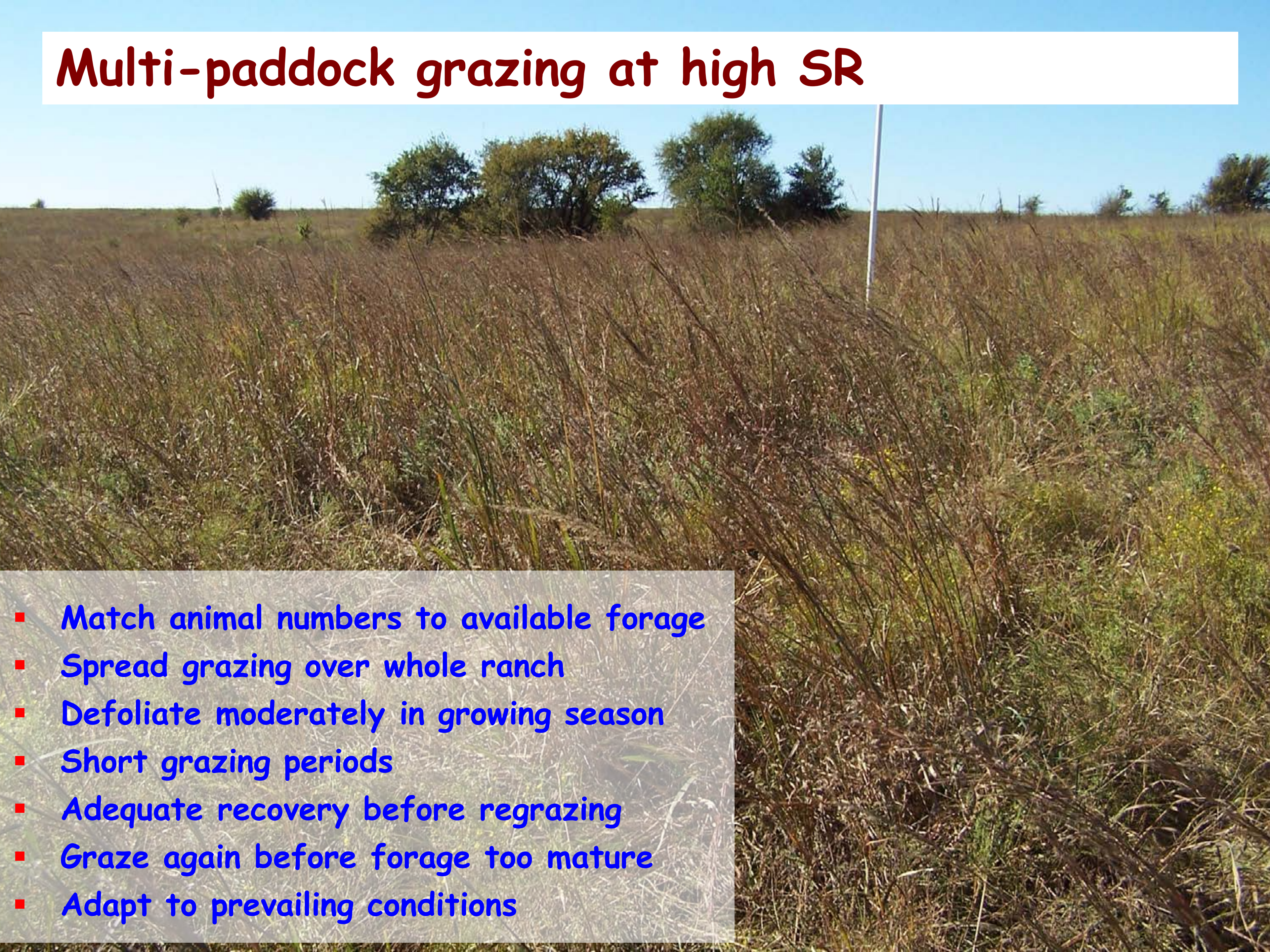
Grazing treatment at least 10 years

Continuous grazing at high SR

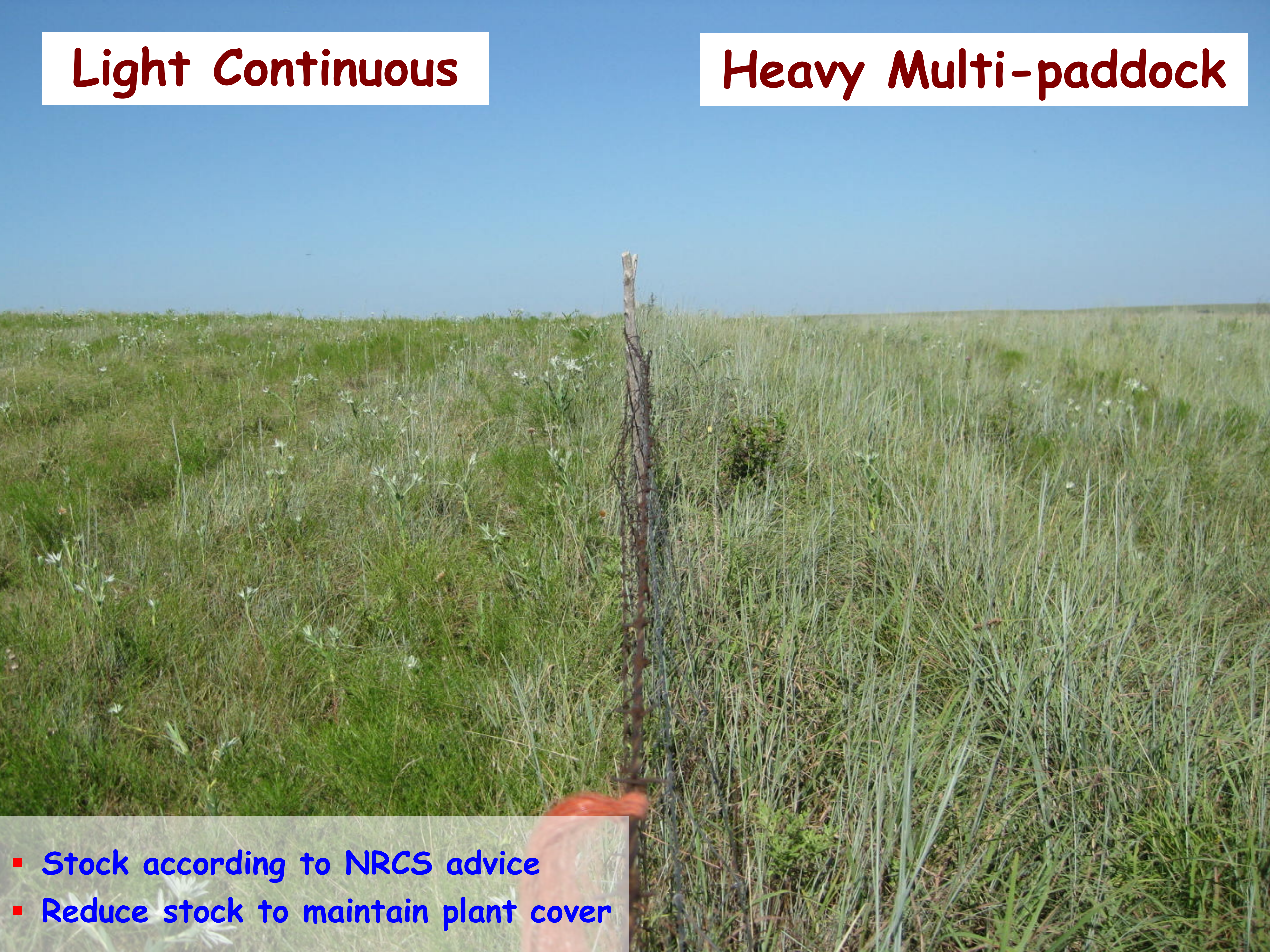


- Stock according to previous practice
- Remove stock if grazing runs out

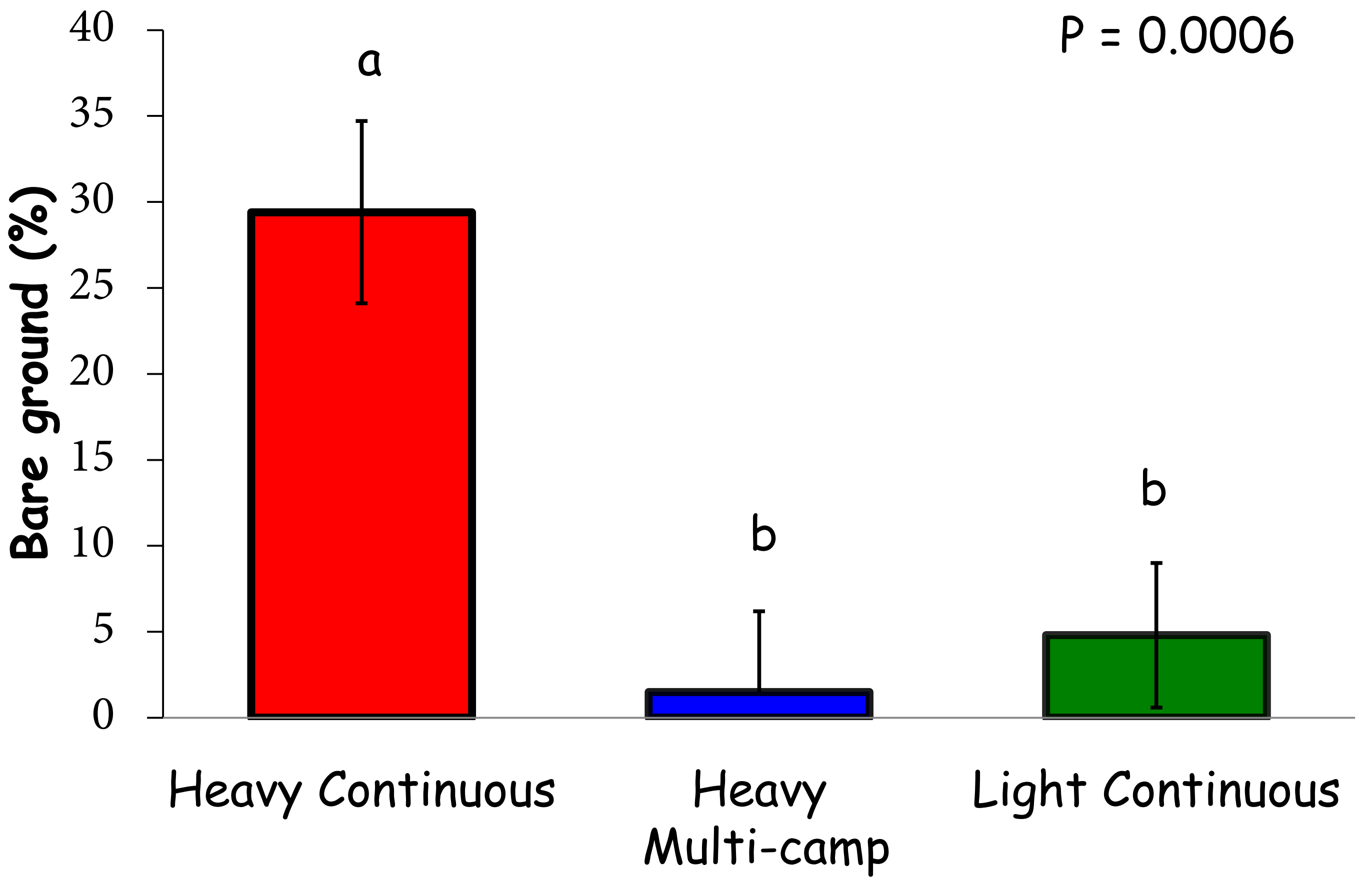
Multi-paddock grazing at high SR



- Match animal numbers to available forage
- Spread grazing over whole ranch
- Defoliate moderately in growing season
- Short grazing periods
- Adequate recovery before regrazing
- Graze again before forage too mature
- Adapt to prevailing conditions


Light Continuous
Heavy Multi-paddock
Stock according to NRCS advice
Reduce stock to maintain plant cover

Bare Ground



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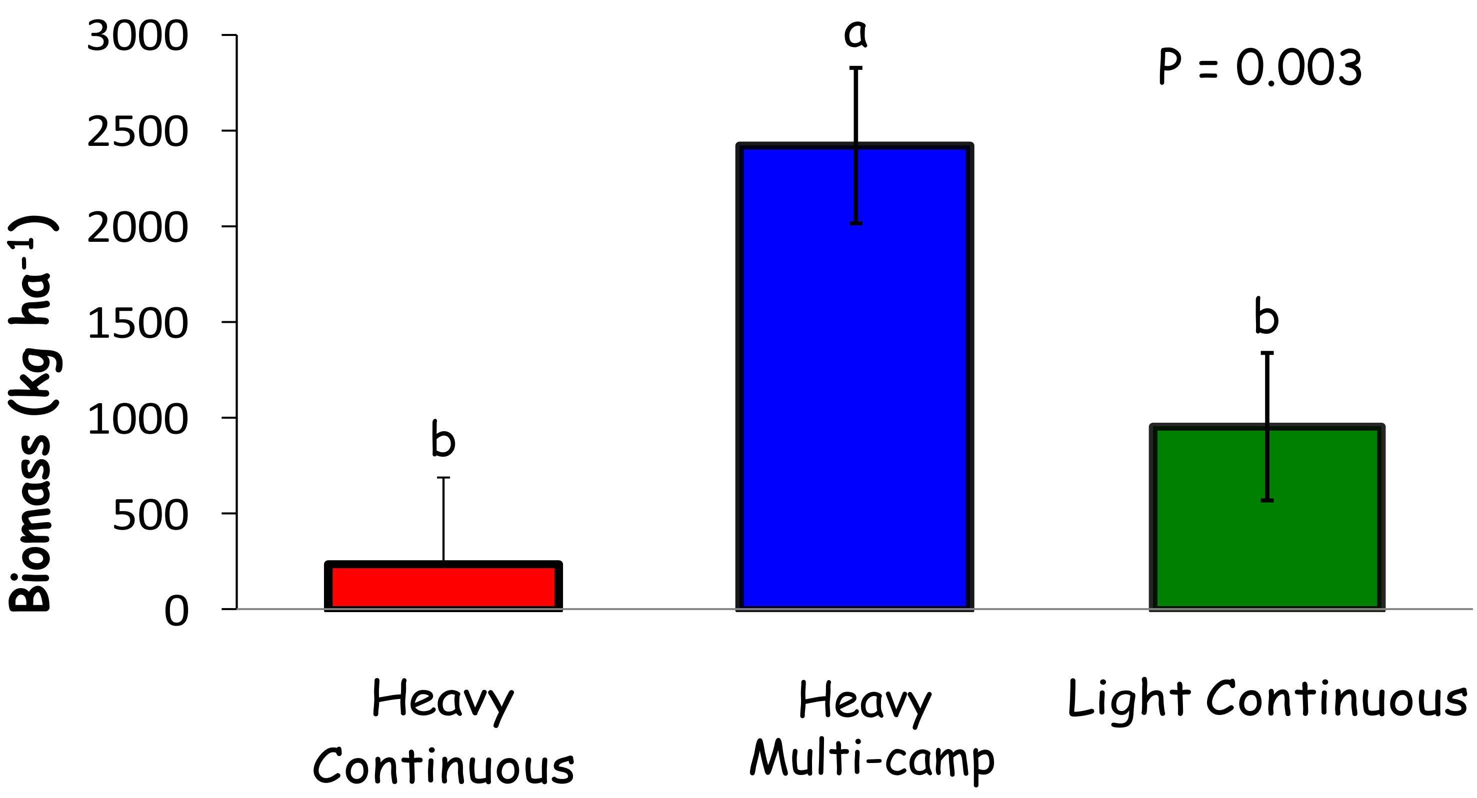
Tall Grasses



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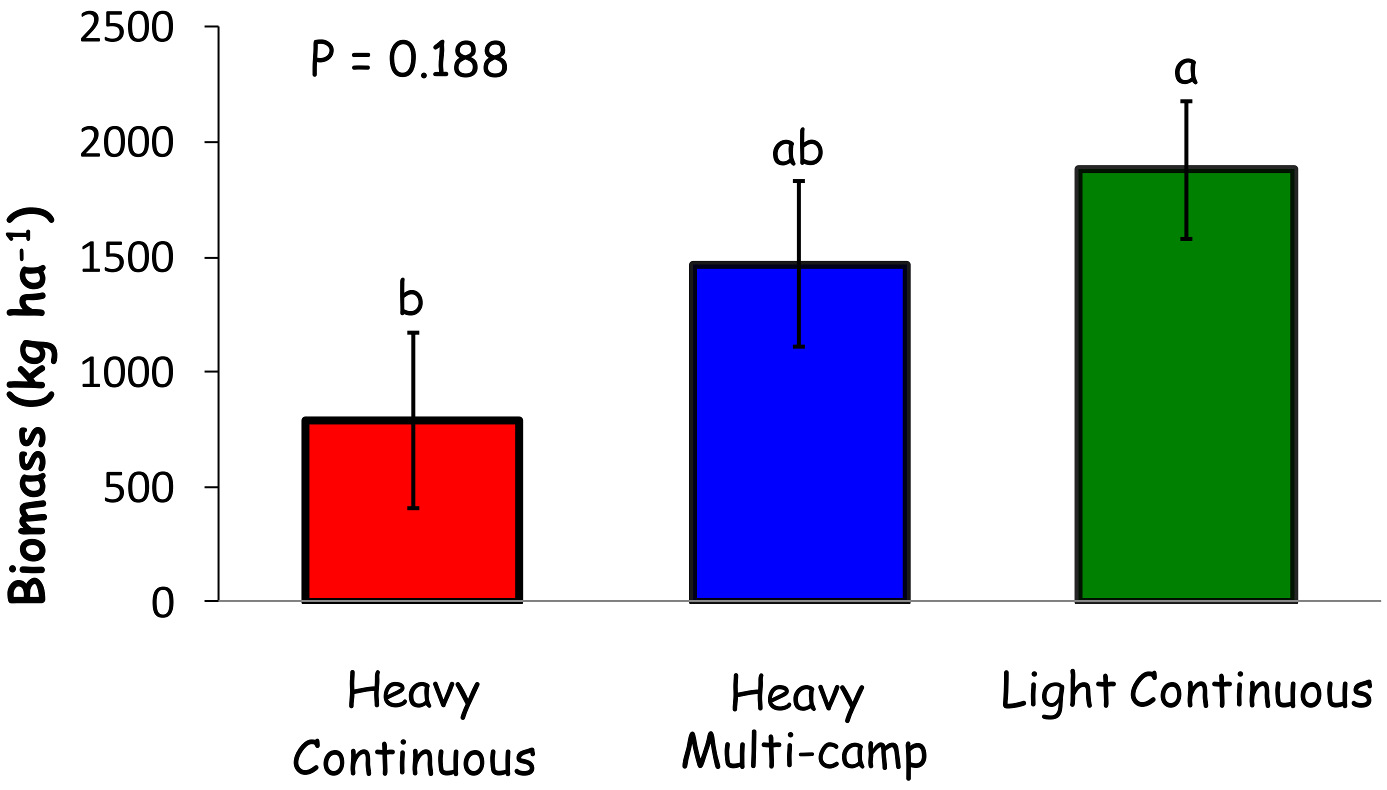
Mid Grasses



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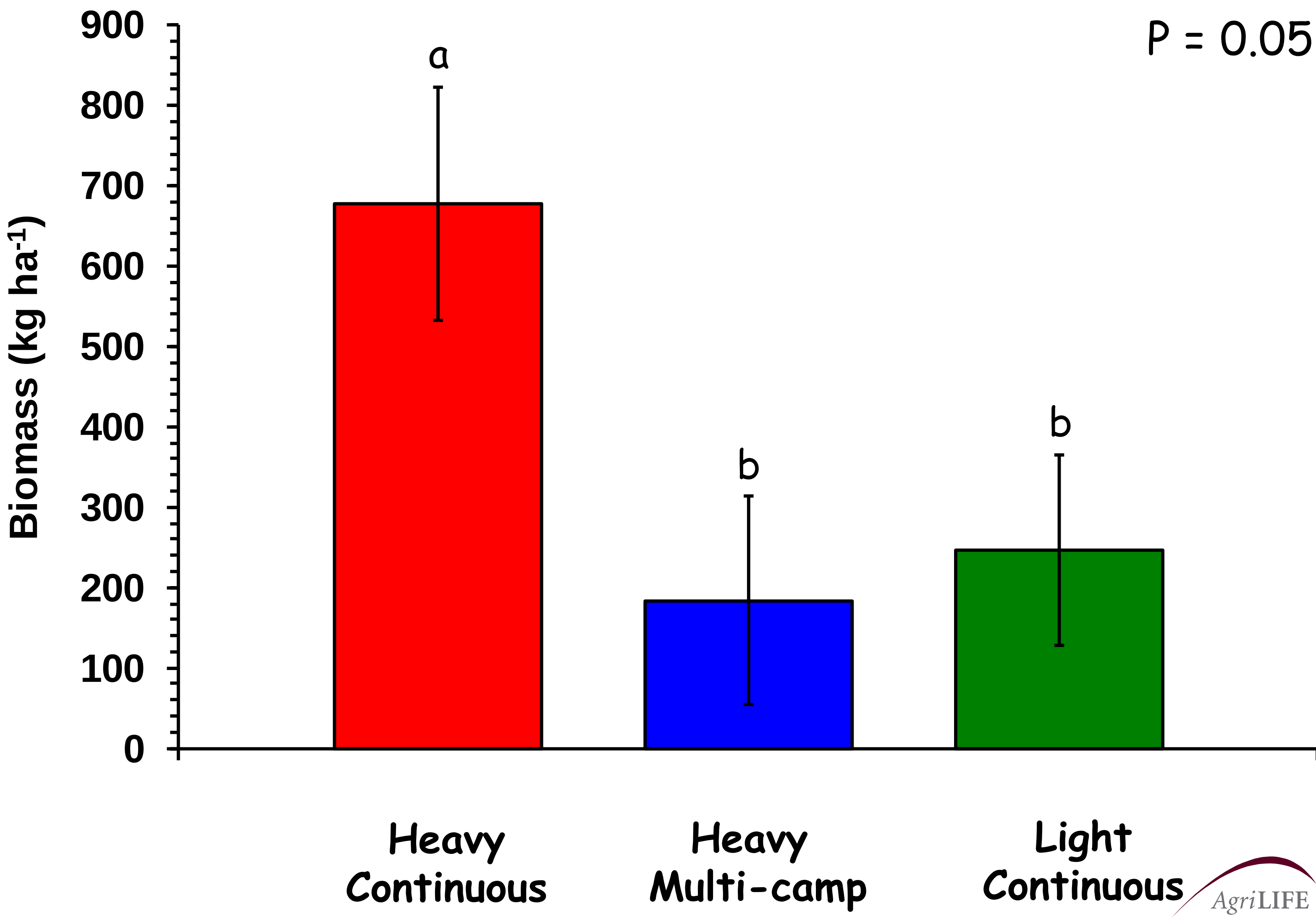
Cool Grasses



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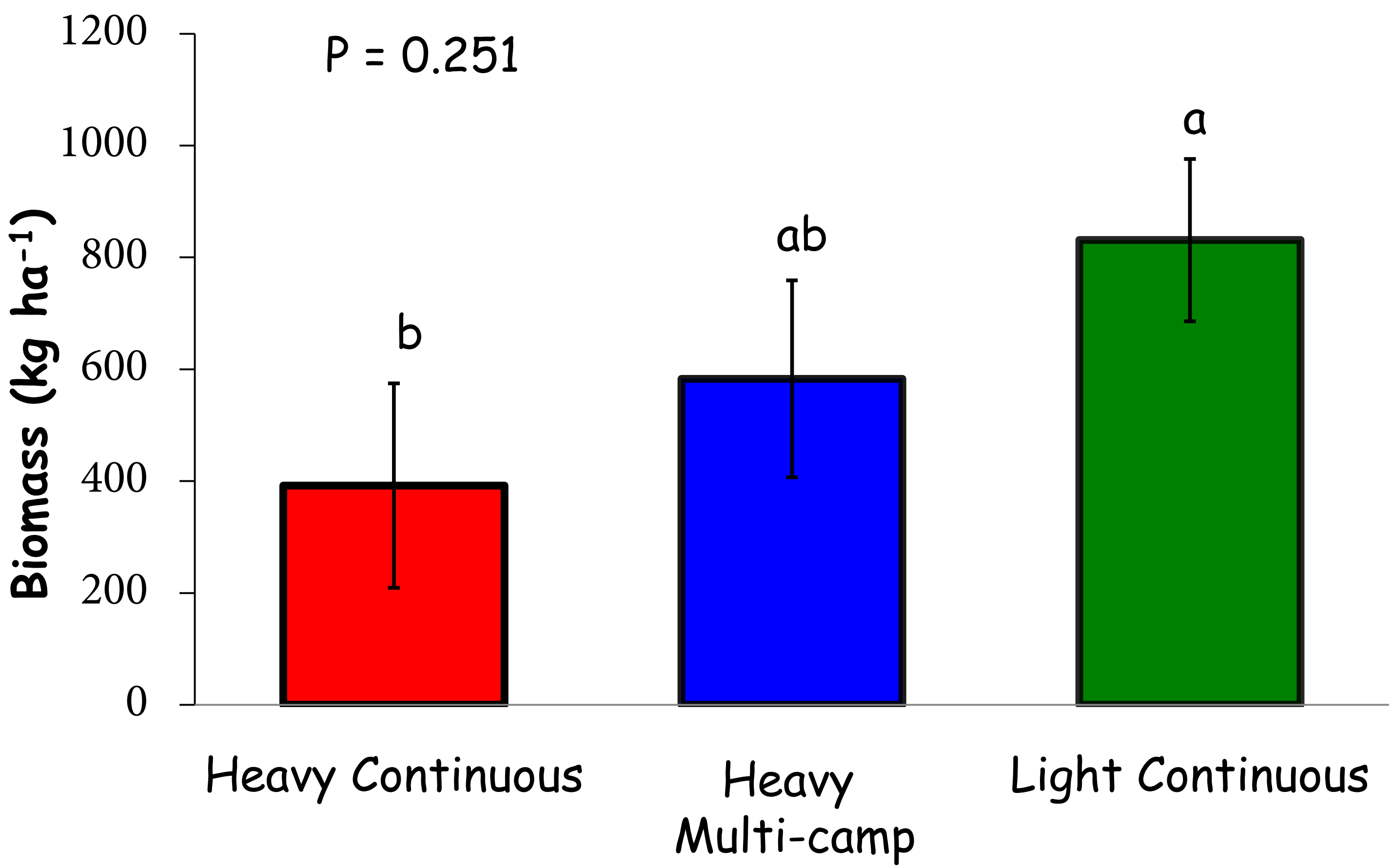
Perennial Forbs



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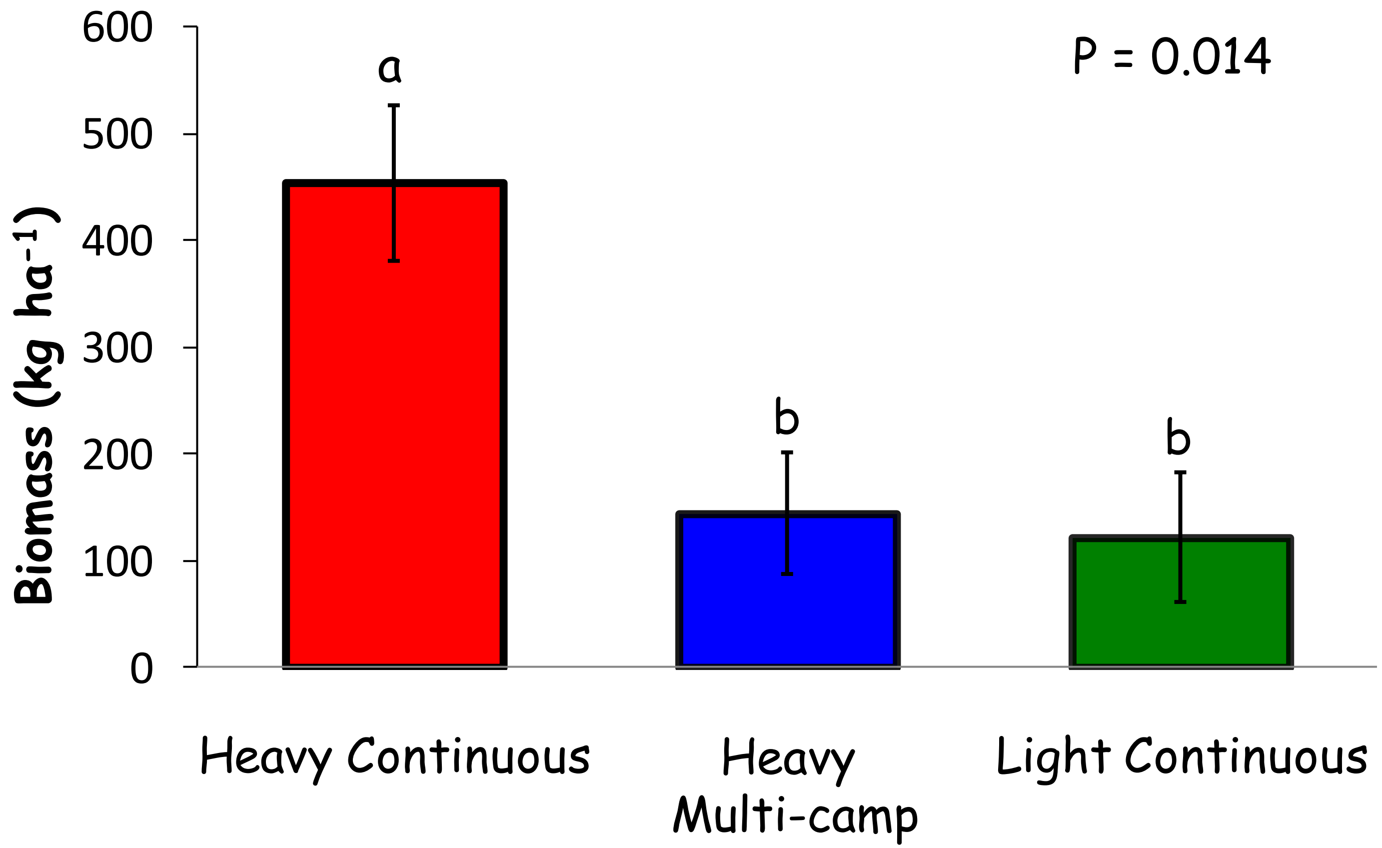
Annual Forbs



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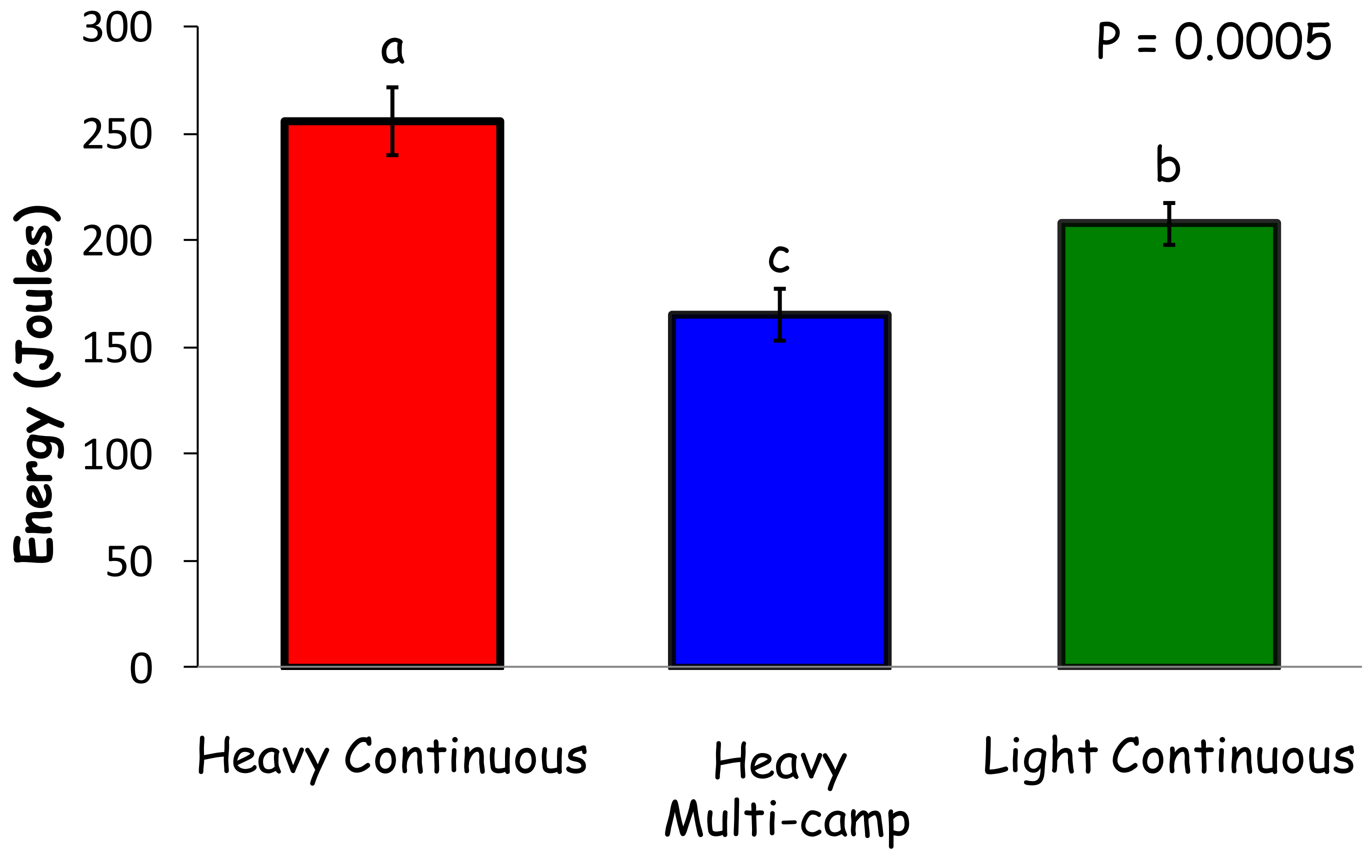
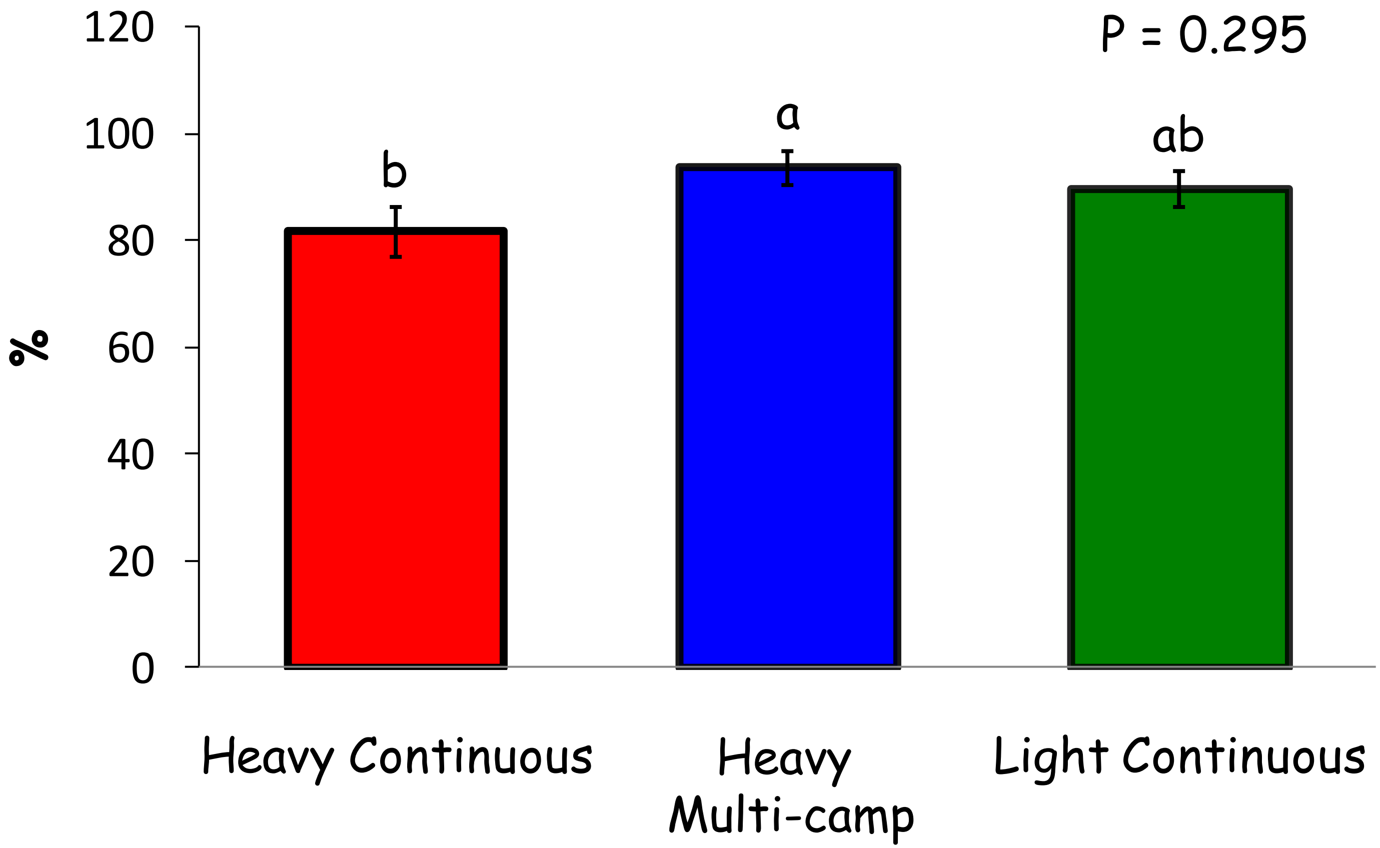
Penetration Resistance

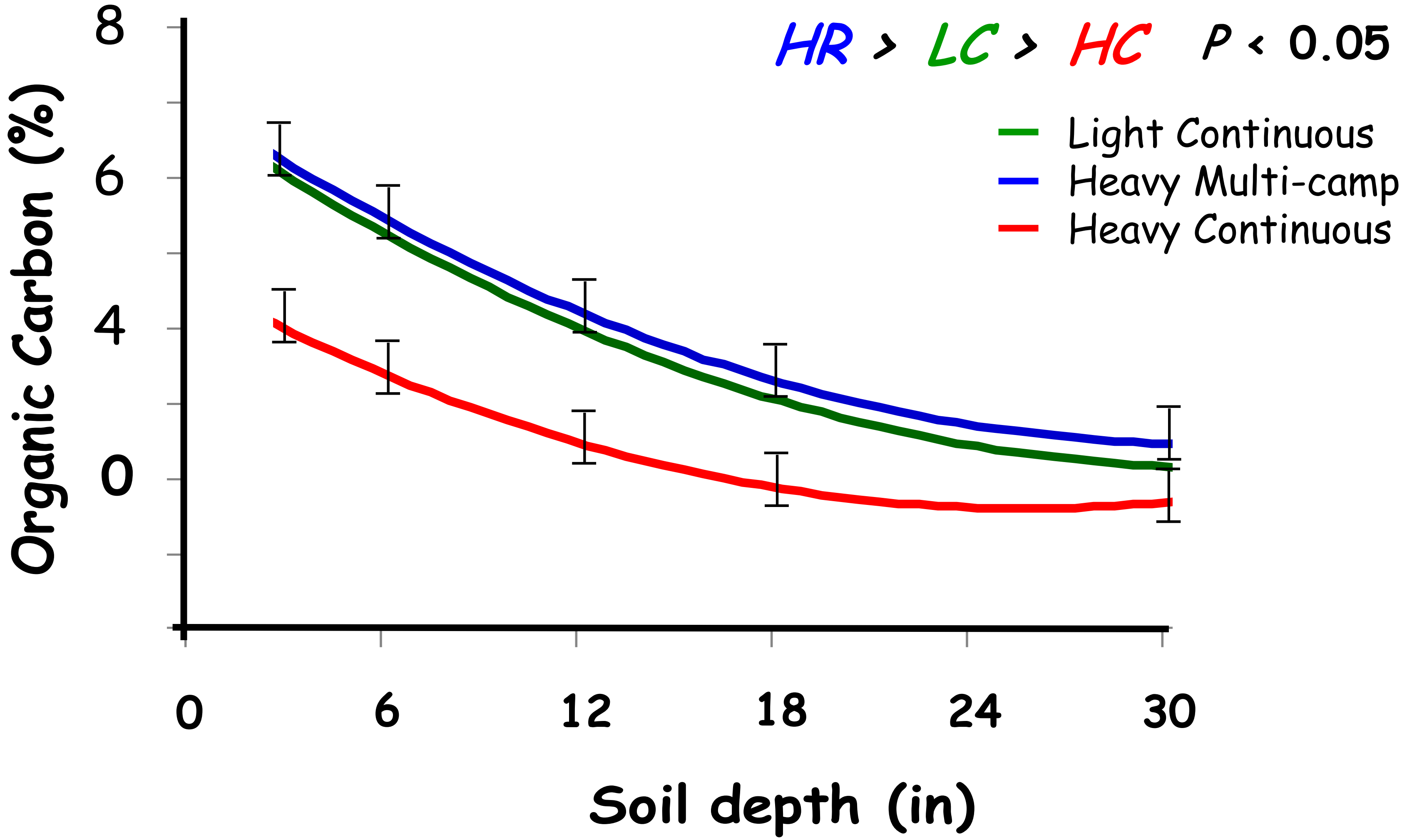


Aggregate Stability



Soil Organic Carbon

NB The *difference* between HR and HC is 30 tons/ha



Soil Carbon and Water

Relationship between soil organic carbon and soil water holding capacity (0-30 cm)

From Jones 2006

Change in SOC concentration	Change in OC stock (kg/m^2)	Extra water holding (litres/ha)	CO_2 sequestered (t/ha)
1%	4.2	168,000	154
2%	8.4	336,000	308
3%	12.6	504,000	462
4%	16.8	672,000	616

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Soil Carbon, Nutrients and Water

Relationship between soil organic carbon and soil water holding capacity (0-30 cm)

Parameter	Heavy Continuous	Light Continuous	Multi-paddock
Soil Organic Carbon	3.1b	4.4b	4.86a
Cation Exchange Capacity	24.6b	23.7b	27.4a
Water holding (Gal/acre)	55,700	79,059	87,324

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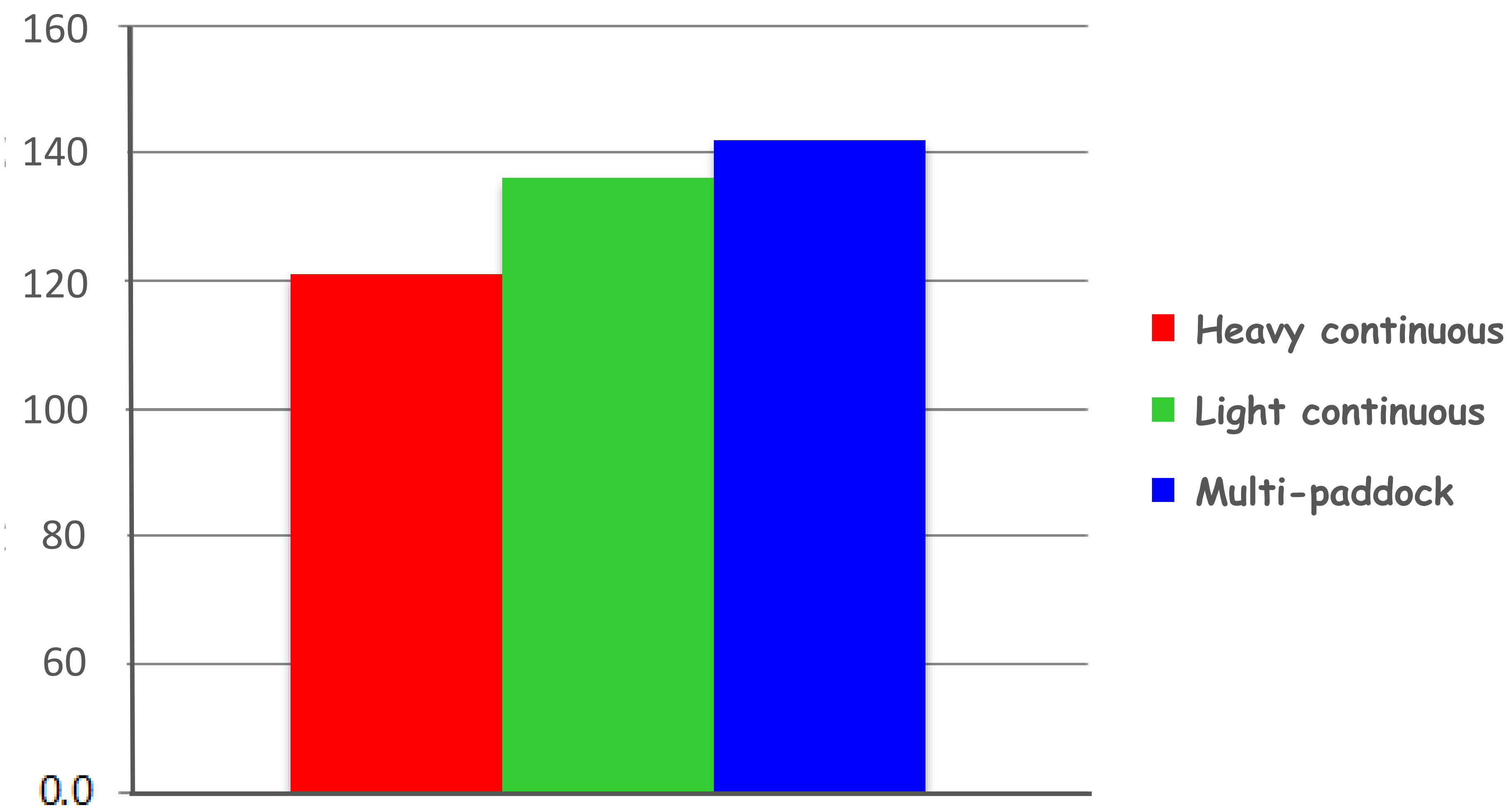
Total Carbon Stock in Top 90 cm (t/ha)



Russ Conser SHELL *pers comm*

Summary

Successful multi-paddocks managers use:

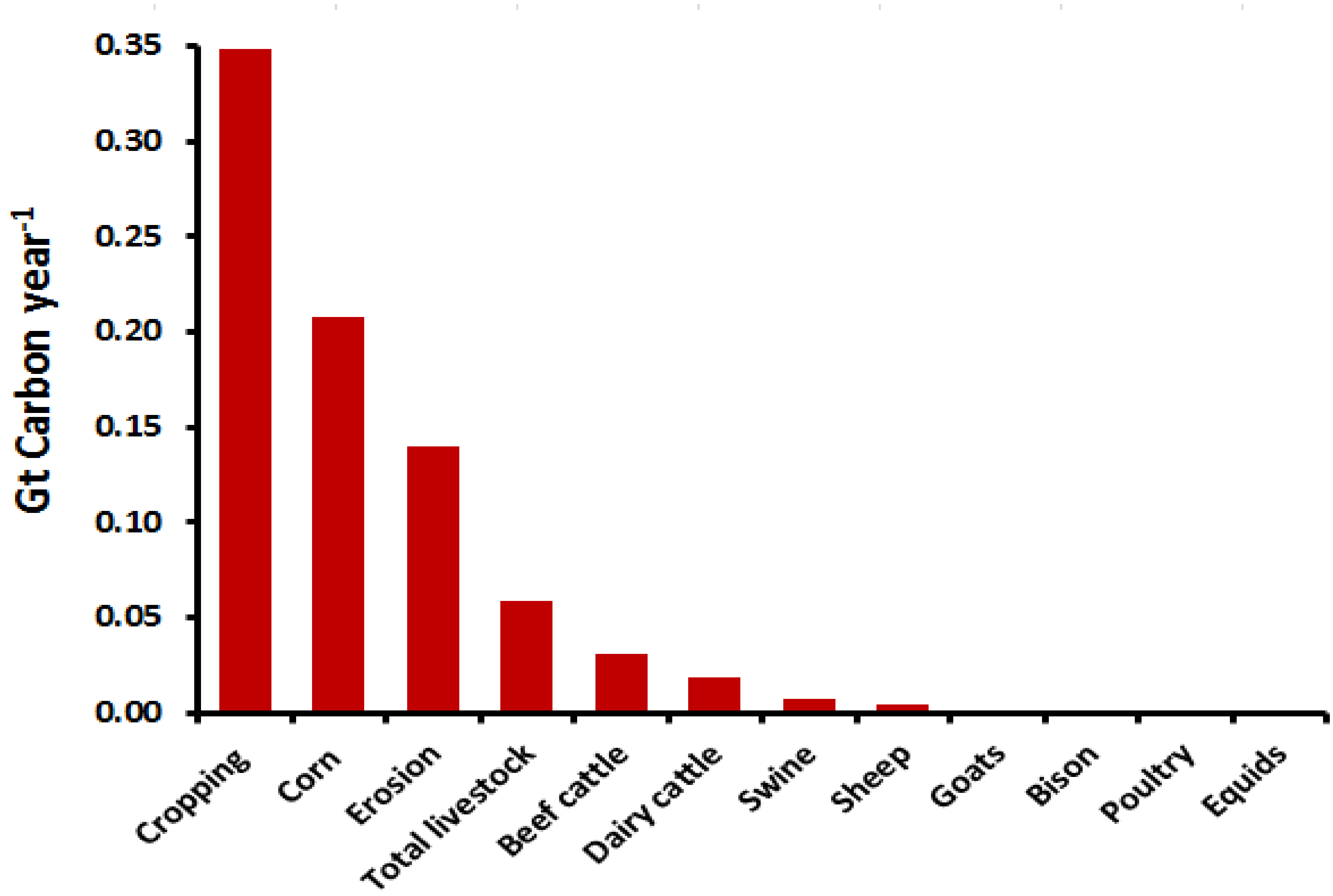
- Flexible stocking to match forage availability and animal numbers
- Spread grazing over whole ranch
- Moderate grazing during growing season
- Short graze periods
- Allow recovery before regrazing
- Graze again before forage too mature
- Adaptively adjust to prevailing conditions

Conclusions

Appropriate regenerative grazing management:

- Sequesters more soil carbon
- Improves watershed function
- Improves species composition
- Stabilizes soil and soil fertility
- Enhances wildlife and biodiversity
- Improves economic returns while improving the resource base

Importance for Climate Change Mitigation?



Importance for Climate Change Mitigation?

Data from the Northern Great Plains shows carbon sinks of:

- Light continuous grazing -0.783 tons CO_{2eq} /ha/yr
- With enteric methane of 0.176 tons CO_{2eq} /ha/yr
- Heavy continuous grazing -0.618 tons CO_{2eq} /ha/yr
- With enteric methane of 0.484 tons CO_{2eq} /ha/yr

Our data from Southern tallgrass prairie

- Optimally managed multi-paddock grazing sequestered 11 tons CO_{2eq} /ha/yr *more* than heavy continuous grazing

Importance for Climate Change Mitigation?

Using regenerative grazing management to:

- Build SOC levels and soil microbial functions
- Control erosion more effectively

Will result in soils being a net sink for agricultural GHGs rather than a major source of GHGs as at present.


END