

Carrying Capacity Enhancement with Intensified Grazing

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1

Where Are We are Going This Morning?

- Fun – audience involvement
- Site Potential
- Back to Basics – Plant Physiology
- Some examples
- Management acumen

2

Site Potential

soils, plant communities, climate/weather, and topography

• Photo credit: Justin Derner

3

Invasive/problem species

change water and nitrogen dynamics, lower forage production, and restrict access to forage

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4

Invasive/problem species

change water and nitrogen dynamics, lower forage production, and restrict access to forage

• Photo credit: unl.beef

5

LOSING PRODUCTIVE RANGELANDS IN OKLAHOMA

Statewide Rangeland Production in 2019: 61.4 billion lbs

Grassland converted to woodland on rangelands since 1990: 9,987,428 ac

Loss in 2019	Loss 1990-2019
8.9 billion lbs	153 billion lbs
(13% of total) forage lost is equal to...	
7.5 million Round Bales (1,200 lbs)	128 million
forage lost could support...	
728,069 Cows (1,300 lbs/yr)	12 million
3.2 million Steers (700 lbs/6mos)	55 million

6

“Improved” plant communities

monoculture or simple mixtures

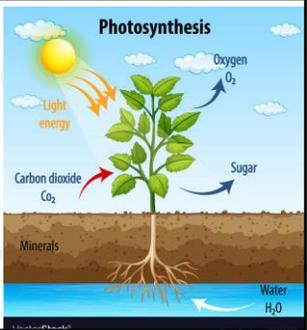
managed with agronomic rather than ecological principles



• Photo credit: Scott Bauer

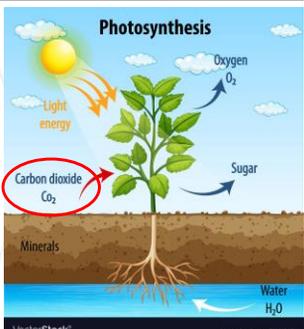
7

Back to Basics: Plant Physiology



8

Back to Basics: Plant Physiology (influencing CO₂)

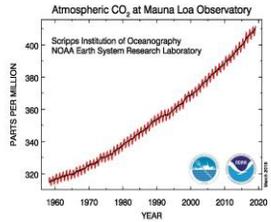


9

CO₂ changes

30% increase from 1958 to current

Benefits C3 (cool-season) more than C4 (warm-season) plants



10

CO₂ changes

60% increase in forage production from 1940s-1960s to current (Includes recovery from Dust Bowl too, Raynor et al. 2021, Rangeland Ecology and Management)

Experimental 26-47% increase in shortgrass steppe (Morgan et al 2001 Global Change Biology) and >25% increase in northern mixedgrass prairie (Mueller et al. 2016 Ecology Letters)



• Photo credit: Matt Mortenson

11

CO₂ changes

Beneficial for forage quantity

BUT, reduced forage quality (Augustine et al. 2018, Ecological Applications)

Faster plant maturity “Summer slump”

Supplemental protein needs



• Photo credit: David Augustine

12

**Back to Basics:
Plant Physiology
(influencing H₂O)**

The diagram illustrates the process of photosynthesis in a plant. Light energy from the sun enters the plant. Carbon dioxide (CO₂) is taken up from the atmosphere. Water (H₂O) is taken up from the soil through the roots. Inside the plant, these combine to produce oxygen (O₂) and sugar. Minerals are also shown being taken up from the soil. The H₂O label in the bottom right is circled in red.

13

H₂O changes

- pitting
- deep ripping
- contouring
- snow fences

disturbance
energy intensive

The image shows the cover of the book 'Range Development and Improvements' by John F. Valentine, Third Edition. The cover features a landscape with a field and a fence under a blue sky.

14

H₂O changes

improving soil health
for greater infiltration
and water holding capacity

cover, living roots,
biodiversity, minimize
disturbance

- Photo credit: David Augustine

A photograph showing a herd of cattle grazing in a lush, green grassy field under a clear sky.

15

Plant Physiology

- growing points
- bud banks, rhizomes,
- growth form,
- carbohydrate reserves,
- season of growth

- Photo credit: Mary Ashby

A photograph of a field with tall green grasses and several bright orange flowers in the foreground.

16

Regrowth

needs:
adequate soil water,
conductive temperatures,
sunlight, available growing
points, leaf area

Simple vs complex plant
communities

- Photo credit: Justin Derner

A photograph of a metal windmill standing in a dry, open landscape with a clear blue sky.

17

Harvest efficiency

Higher stocking density leads
to greater total intake
(Smart et al. 2011, *Rangeland Ecology and Management*)

agronomic vs ecological
principles

Figure 8 consists of two graphs, A and B, showing the relationship between grazing pressure and forage intake. Graph A plots 'Forage Intake (kg/1000)' on the y-axis (0 to 100) against 'Grazing pressure index (AUD-Hg)' on the x-axis (0 to 70). It shows a curve for 'total disappearance' that increases with grazing pressure, and a curve for 'forage intake by livestock' that increases up to a point and then declines. Graph B plots 'Forage Intake (kg/1000)' on the y-axis (0 to 100) against 'Forage allowance (kg/1000)' on the x-axis (0 to 140). It shows a similar trend where total disappearance increases with forage allowance, and forage intake by livestock increases up to a point and then declines.

Figure 8. Forage intake by livestock (average of the three harvest efficiency models) and total disappearance as related to A, grazing pressure index and B, forage allowance. Because forage intake by livestock and total disappearance were disproportionately more efficient levels of grazing pressure index or forage allowance, grazing efficiency increases from low grazing pressure to high grazing pressure or high forage allowance to low forage allowance. AUD indicates animal unit days.

18

Examples of increased carrying capacity

targeted grazing in the spring

use vs “lose” this forage



• Photo credit: David Augustine

19

Examples of increased carrying capacity

use multiple species (sheep, goats)

Barriers?
infrastructure, labor and/or equipment and social acceptance (Adhikari et al. 2023 *Rangeland Ecology and Management*)



• Photo credit: ARS K4166-5

20

Examples of increased carrying capacity

Intensive Early Stocking (IES) followed by non-use and then late-season or dormant season grazing (Owensby and Auen 2013, *Rangeland Ecology and Management*)



• Photo credit: David Augustine

21

Management Acumen

Improved grazing distribution

additional water, placement of supplements, animal selection, herding, fencing (Bailey 2014, *Journal of Animal Science*)



• Photo credit: Matt Mortenson

22

Management Acumen

Emergent tools like virtual fence

Riparian areas, critical wildlife habitat, wildlife corridors, targeted grazing, chasing the “green”, fire breaks (Boyd et al. 2023 *Rangeland Ecology and Management*)



• Photo credit: Melissa Johnston

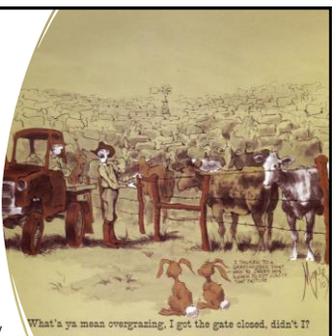
23

Summary

Benefits have already occurred and continue with elevated CO₂ and emphasis on soil health

Agronomic vs ecological principles

Opportunities: targeted grazing, mixed-species grazing, growing season and dormant use



• Cartoon credit: Herb Mignery

24

Final
answer...

Flexible
fences 😊



• Photo credit: Justin Derner