Vegetation Responses to Grazing: Have Unifying Principles Emerged?

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Presentation Objectives

- Have unifying principles emerged to describe vegetation responses to grazing?
- Do these principles support the design and application of specific grazing systems?
- What are the ecological mechanisms underpinning these answers?

Unifying Principles Describing Vegetation Responses to Grazing

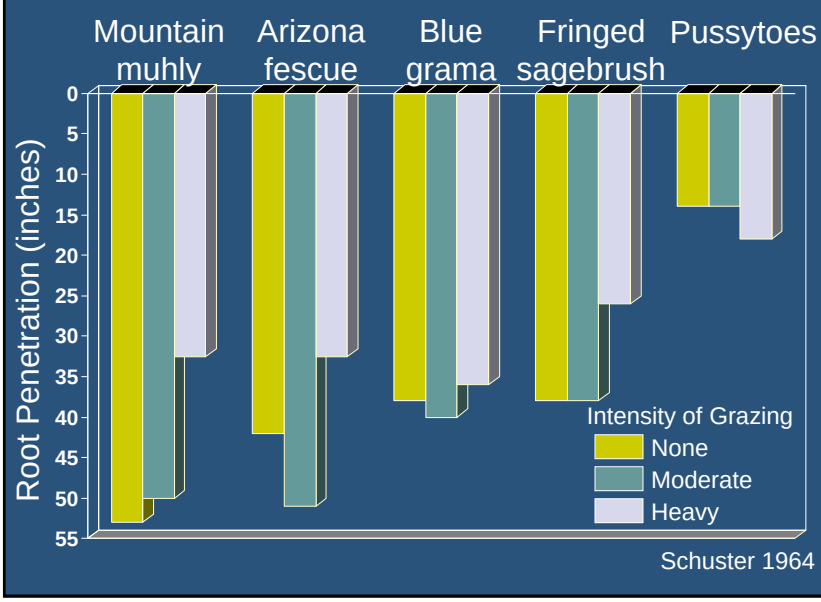
- Chronic, intensive grazing is detrimental
- Species composition can be modified
- Forage quality can be altered
- Plant production can be affected

Photo NRCS

Briske and Heitschmidt 1991

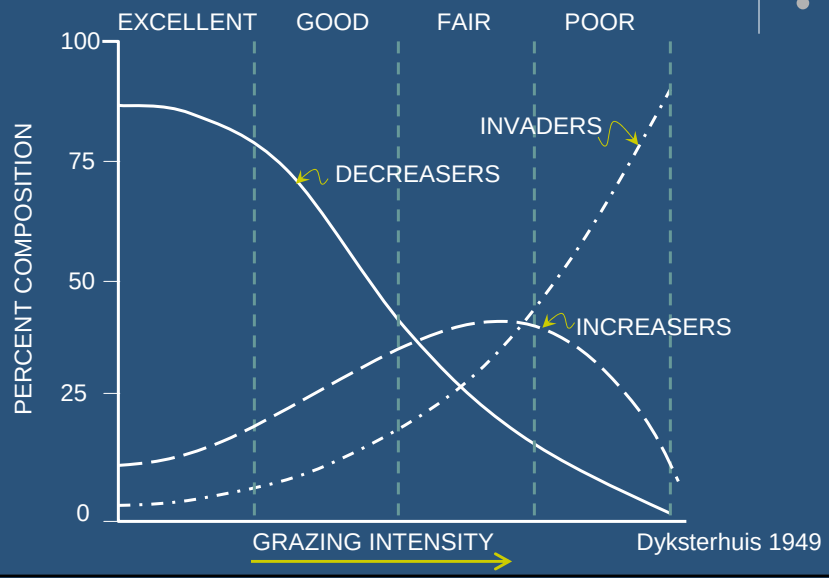
Severe Grazing can Reduce Photosynthesis and Growth

Vertical Root Response



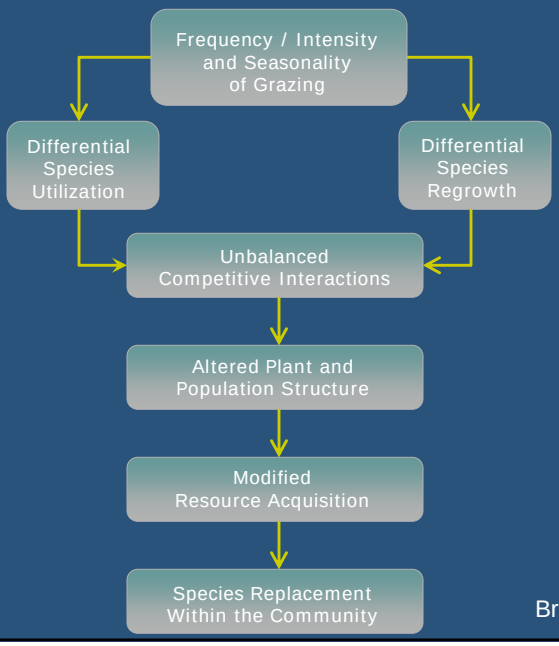
Schuster 1964

Condition and Trend Classification



Dyksterhuis 1949

Mechanism of Species Replacement



Briske 1991

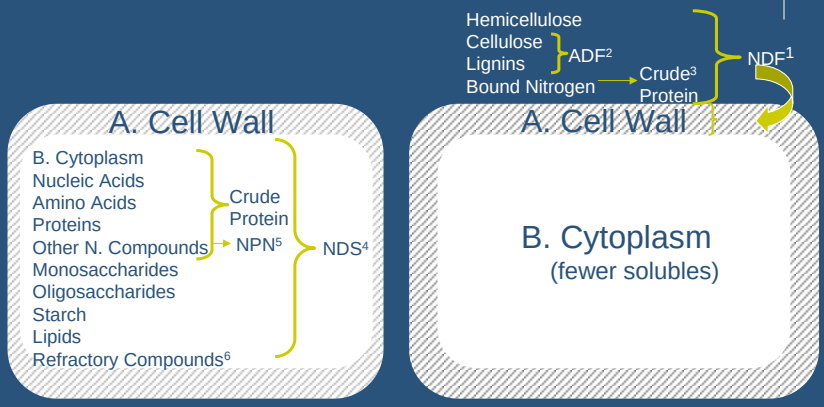
Nutritional Properties of Grasses

Nutritional Property	HUI	Season			Significance	
		Early	Mid	Late	Season	HUI
Crude Protein	Low	23·0	17·4	10·0	**	**
	High	30·6	23·7	16·7		
Cell Contents	Low	35·7	28·2	27·5	**	*
	High	42·7	33·4	29·5		
Cell Wall	Low	49·1	55·7	54·5	*	*
	High	43·9	51·8	52·4		
Cellulose	Low	21·0	23·9	26·4	**	**
	High	16·1	19·2	20·4		
Lignin	Low	2·8	3·7	3·8	**	*
	High	2·0	3·0	3·5		

*P < 0·05,**P<0.005.
N.S., not significant.

Georgiadis & McNaughton 1990

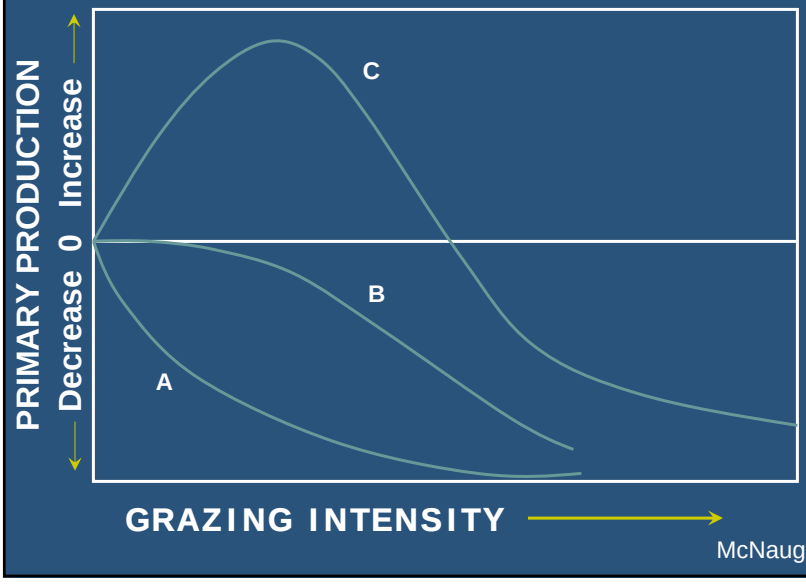
Processes Influencing Forage Quality



a. Young Tissue	Versus	Old Tissue
b. Leaf Tissue	Versus	Stem Tissue
c. C_3 Plants	Versus	C_4 Plants

Huston and Pinchak 1991

Grazing Optimization Hypothesis

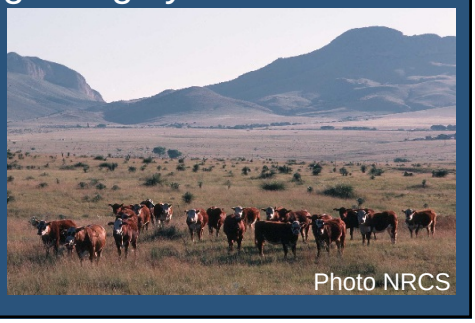


McNaughton 1979

Occurrence of Grazing Optimization

- Occurs in about 25% of comparisons
- Unpredictable and difficult to manage
- Requires long rest periods to occur
- Limited in commercial grazing systems

Belsky 1987
Milchunas and Lauenroth 1993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Do these unifying principles of vegetation response support the design of specific grazing systems?


Photo NRCS

Benefits of Intensive Grazing Systems

- Increased control of grazing patterns
- Improve species composition
- Enhance forage quality
- Promote plant production

Briske and Heitschmidt 1991
Heitschmidt and Taylor 1991

Unifying Principles do not Support Intensive Grazing Systems

- Few advantages exist for intensive compared to continuous grazing systems.
- Stocking rate is more important than type of grazing system.
- Management variables appear to effect vegetation independently of grazing system.

Hart and Norton 1988
Holechek et al. 2001

Conclusion One

- Assumed benefits of intensive grazing have been overextended.
  - Grazing selectivity continues to occur
  - Forage quality is not always improved
  - Forage production is not greatly enhanced

Hart and Norton 1988
Holechek et al. 2001

Why are Grazing Systems Marginalized?

- Stocking rate = animal #/ land area/ unit time
- Grazing pressure = forage demand/ forage available
- Grazing systems designed to redistribute grazing pressure in time and space

Heitschmidt and Taylor 1991

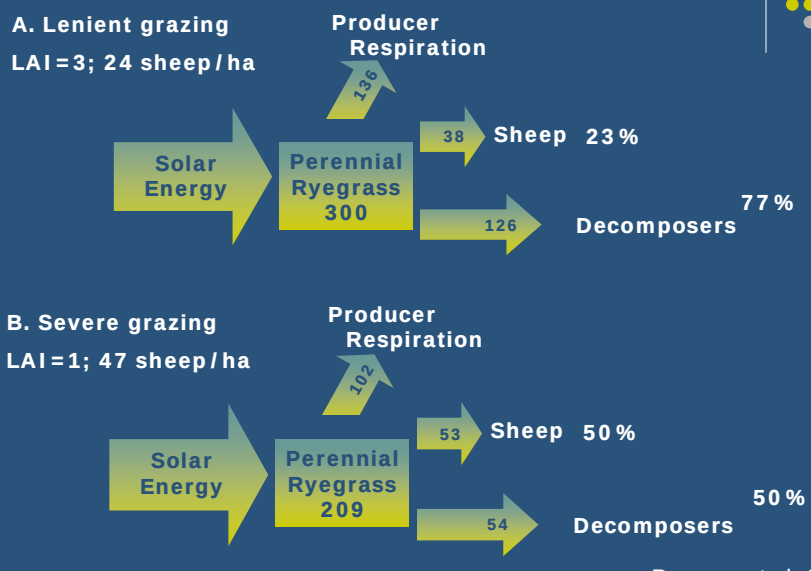
Conclusion Two

- Ecological constraints on grazed ecosystems override unifying principles
  - Grazing management must optimize competing ecological processes
    - i.e., leaf area and harvest efficiency
  - Redistribution of GP has less effect as plant growth and predictability decrease with aridity
    - i.e., reserve forage between growth periods

Briske and Heitschmidt 1991
Holechek et al. 2001

Stocking Rate Effects Energy Flow

(Units=kg C/ha/day)



Parsons et al. 1983

Conclusion (hypothesis?) Three

- Experimental grazing research has only provided part of the answer
- Intensive grazing systems affect management decisions more than ecological processes
  - Commercial benefits of grazing systems are often inconsistent with research results
    - Alter management goals and approaches
    - Promote enterprise restructuring to replace capital inputs with intensive management

Take Home Message

- Grazing management introduced to limit destructive grazing practices.
- Created impression that continuous grazing is unsustainable.
- Grazed ecosystems are influenced by a similar set of environmental constraints.
- Grazing systems modify management decisions apart from ecological processes.

Hart and Norton 1988