Can Goats be a Restoration Tool for Degraded Oak Ecosystems?

Cherrie Nolden[2]

John Harrington[1,2]

Katie Baumann[1]

Julia Ela[3]

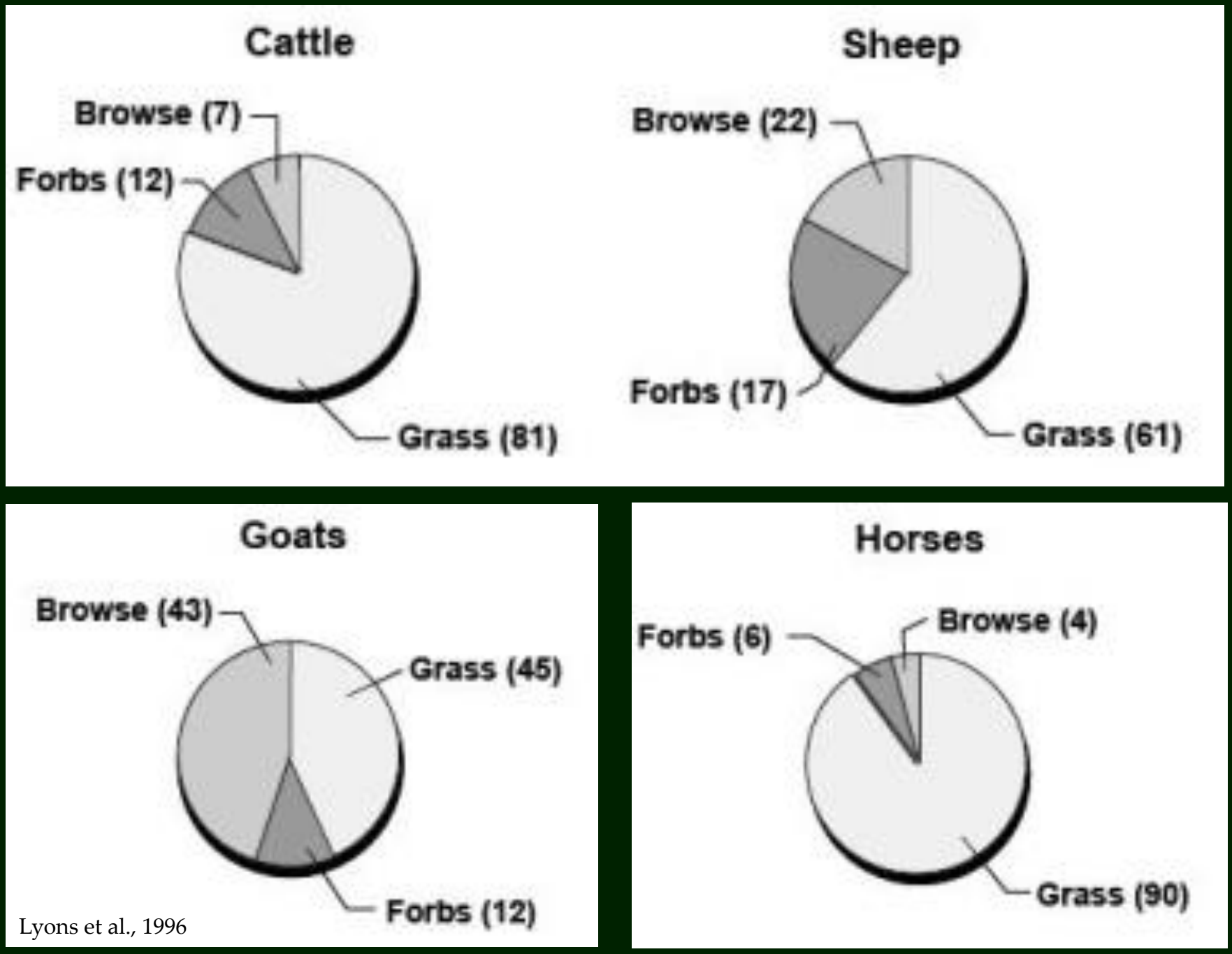
University of Wisconsin, Madison
Department of Landscape Architecture[1],
Agroecology Program[2]
National Fish and Wildlife Foundation[3]

Upper Midwest Invasive Species Conference
October 21, 2014

Katie Baumann

Outline

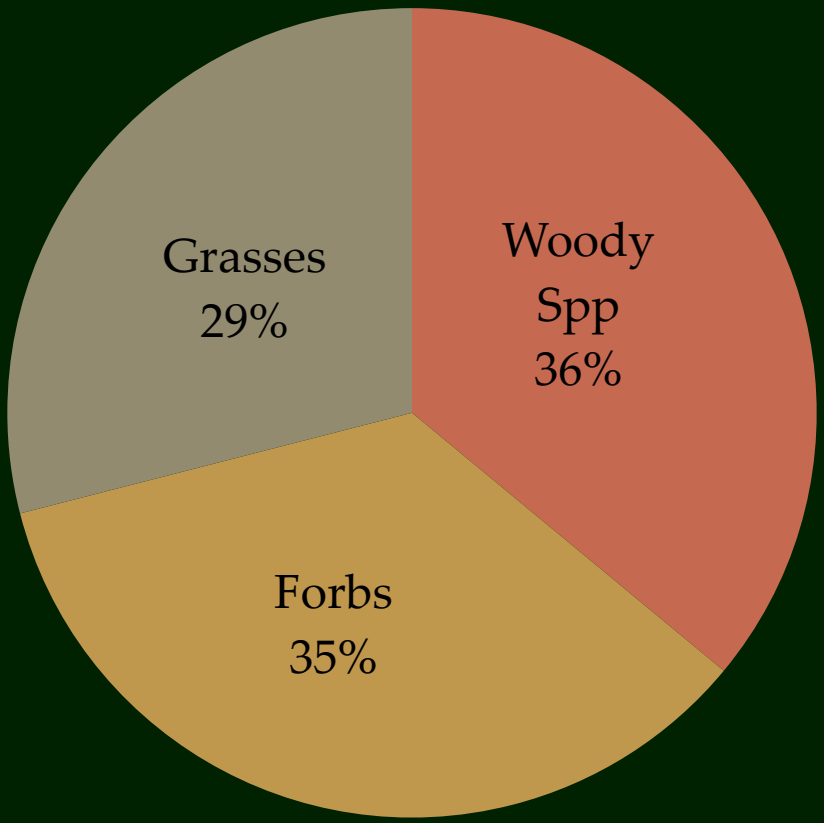
- Background
- Research Objectives
- Study Site
- Methods
  - Experimental Design
  - Data Collection
  - Data Analysis
- Results
- Conclusions
- Acknowledgements



Lyons et al., 1996

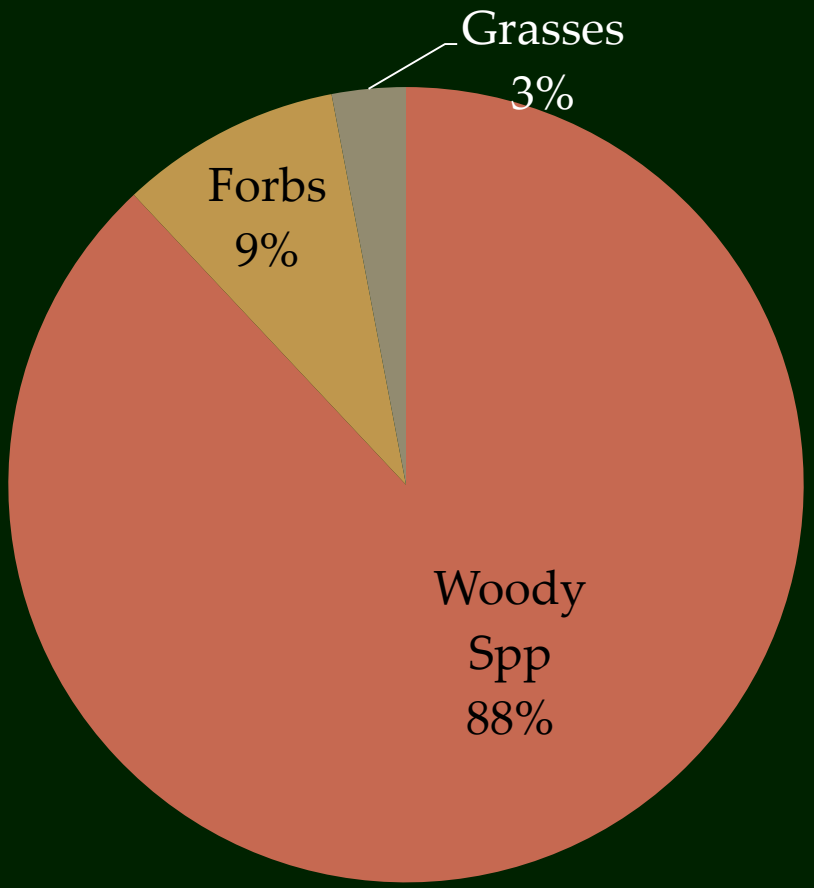
Forage Preferences in WI Oak Savanna

Scottish Highland Cattle



(Harrington and Kathol, 2009)

Meat Goats



(Harrington et al., unpublished data, 2011)

Cherrie Nolden

Livestock for Brush Control

- West Virginia, multiflora rose, 1986
- Goats reduced brush from 45% to 15% in one season
- Sheep required 3 seasons to do the same
  - Mowing/herbiciding improved sheep effectiveness
- Actual goat kill of brush
  - Early season defoliations
  - 5 years, killed 98%
- Management
  - Goats for brush
  - Sheep for forbs
  - Cattle for toppling

(Bryan, 1994)

Goat Production

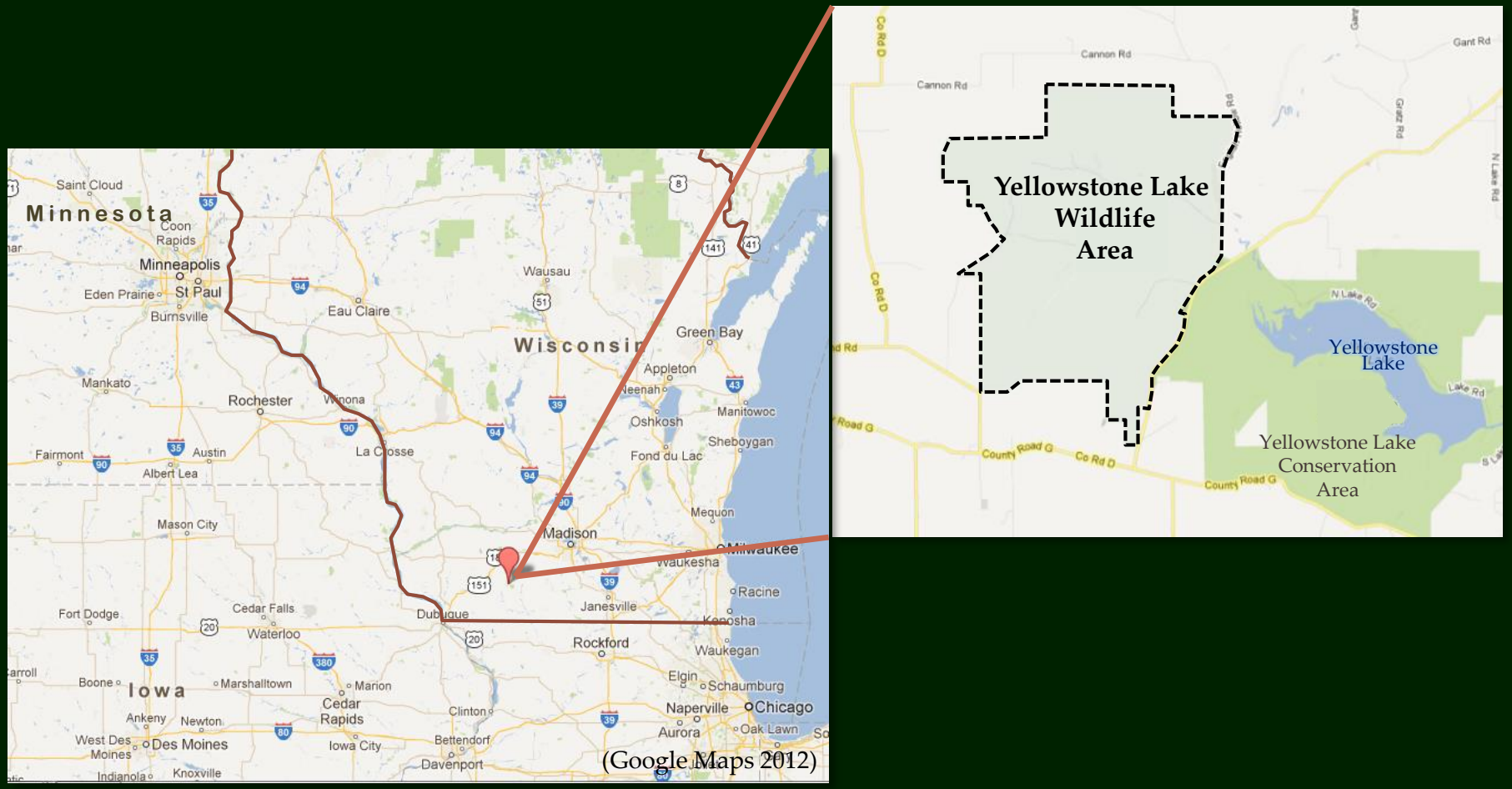
- Meat market
  - 730,000 hd deficiency (Rayer, 2012)
  - Non-traditional demand
    - Omega 3s (Solaiman, 2007)
- Typical regional production
  - Confinement, grain-fed (WDGA, 2013)
  - Dairy buckling ADG: 0.2-0.5 lb/d (Ishler et al., 1998)
  - Boer goat ADG: 0.5-0.7 lb/d (Barry & Godke, 1978)
- Parasite management
  - *Haemonchus contortus*: Barberpole Worm
  - FAMACHA
  - Body Condition Score

1° Research Question:

Can rotational
browsing with goats
be both an
effective
restoration tool
for reducing a
dense shrub midstory
and meet
basic standards for
goat meat production?

Research Site

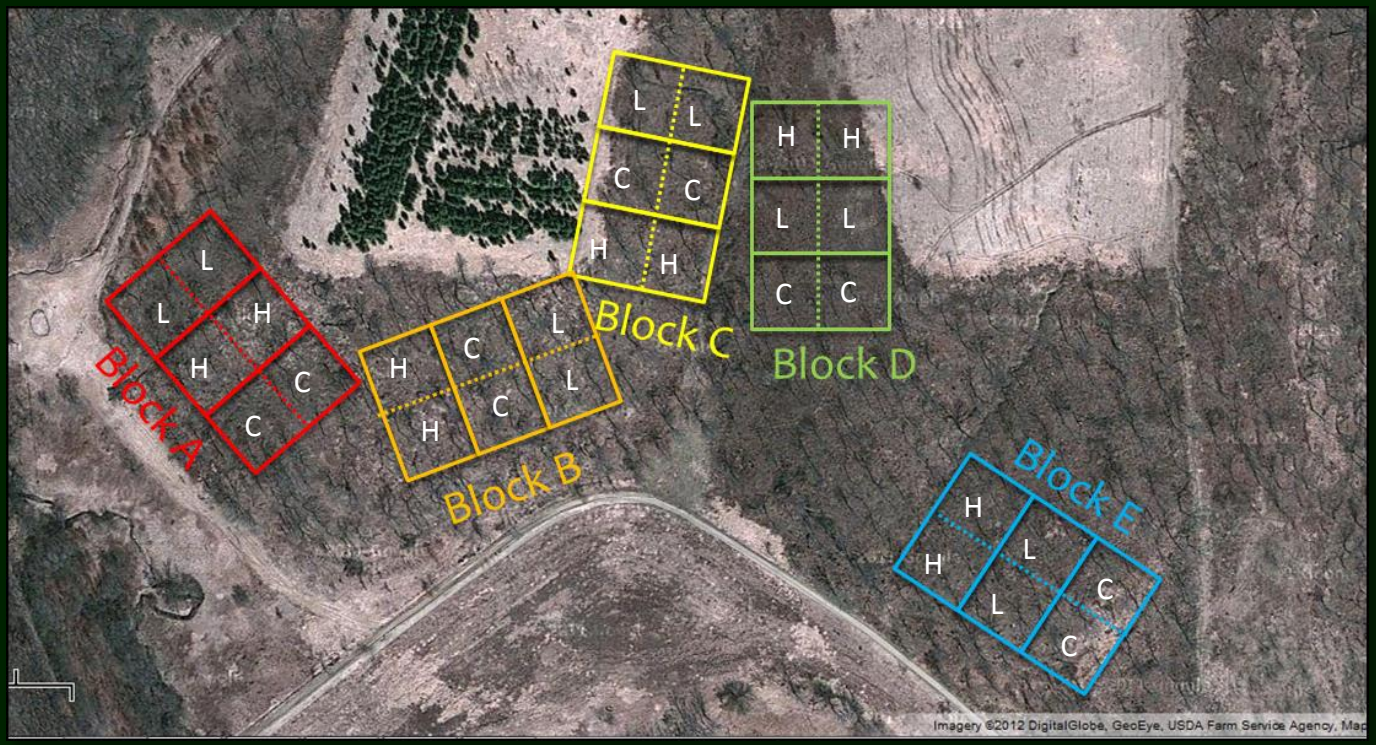
- Yellowstone Lake Wildlife Area, WDNR
- 2008 Tree thinning
- Dense mid-story of closed shrubs



(Google Maps 2012)

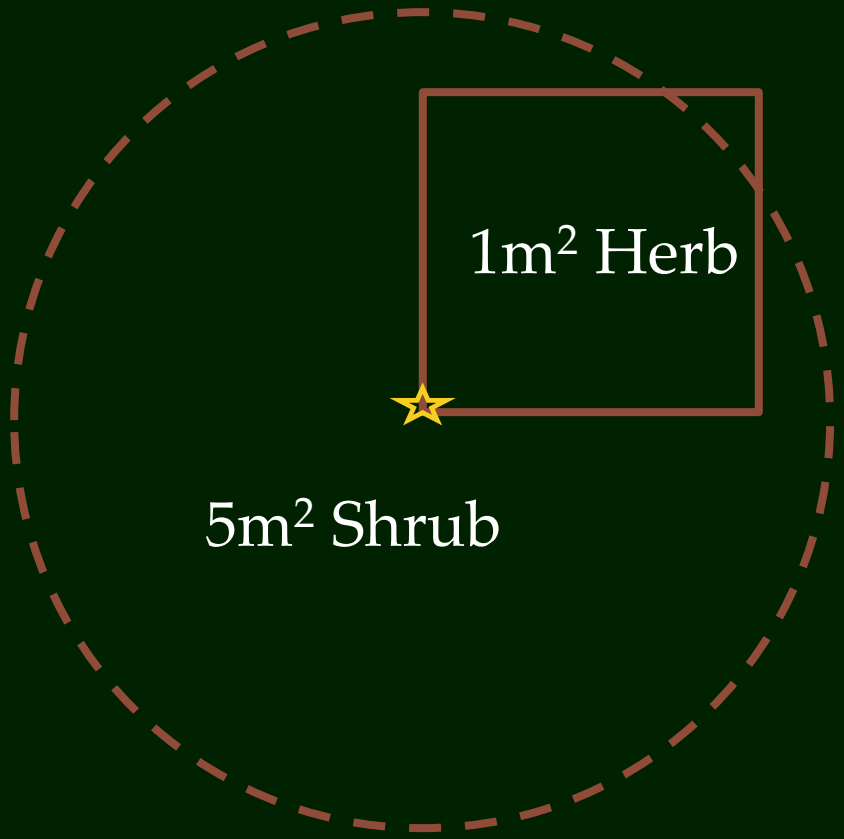
Methods: Experimental Design

- RCBD:
  - 5 blocks
  - 3 treatments
  - 0.5 hectares each
- 3 treatments:
  - "Light" browsing (L)
  - "Heavy" browsing (H)
  - Control (C)
- Goats:
  - 6.4 AUE
  - Mix-breed
  - Meat type



Methods: Vegetation Sampling

- Nested quadrats

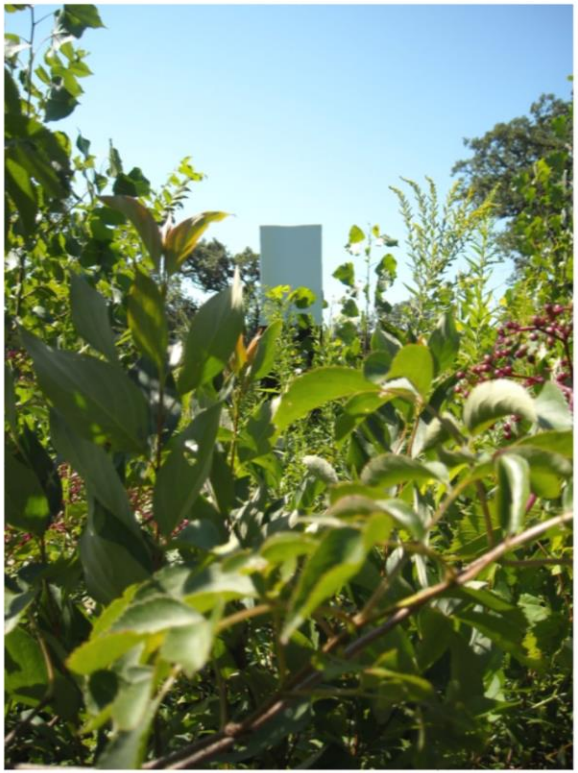


- Coverboard

18 per treatment

Cover Board

Control



Light Browsing

Heavy Browsing

Methods: Variables Examined

SHRUBS	Richness Density Cover Height
HERBACEOUS	Richness Cover
BIOPHYSICAL	Soil compaction Litter depth Light penetration
GOATS	Weight Parasitism Dietary Preference

Methods: Hypotheses

SHRUBS	Richness Density Cover Height	H_0: means equal btwn controls, treatments H_a: means unequal btwn controls, treatments
HERBACEOUS	Richness Cover	
BIOPHYSICAL	Soil compaction Litter depth Light penetration	
GOATS	Weight Parasitism	H_0: no change, H_a: before≠after
	Dietary Preference	H_a: % eaten=cover

Methods: Data Analysis

SHRUBS	Richness Density Cover Height	Repeated Measures ANOVA, $p \leq 0.05$
HERBACEOUS	Richness Cover	
BIOPHYSICAL	Light penetration Soil compaction Litter depth	Student's t-test, $p \leq 0.05$
GOATS	Dietary Preference	
	Weight Parasitism	Paired t-test, $p \leq 0.05$

Shrub Results

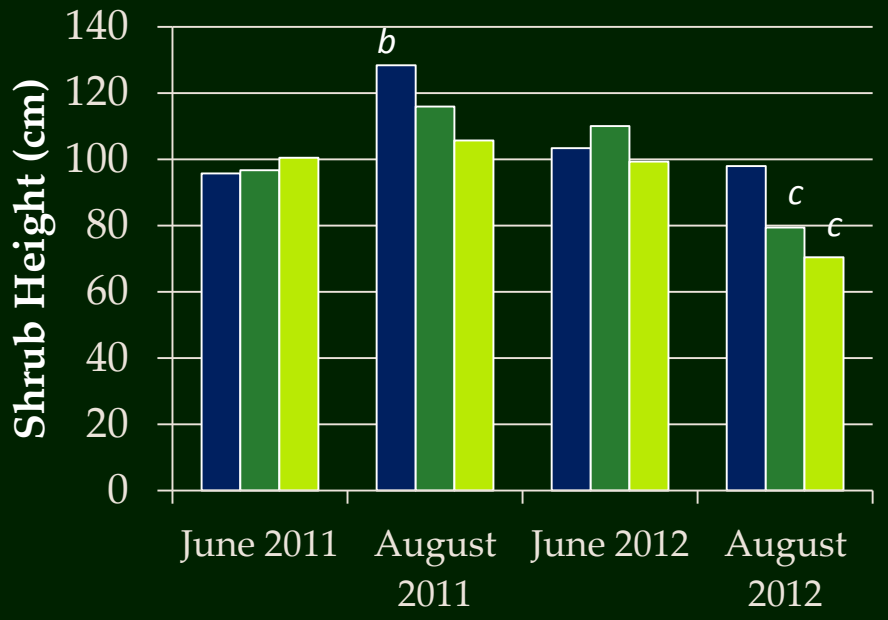
$p < 0.05$

a = difference from control

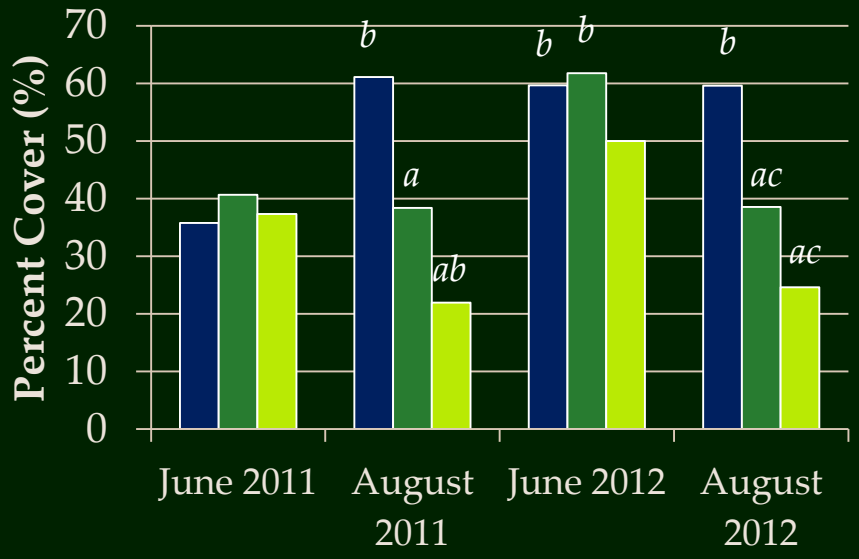
b = difference from same in June 2011

c = difference from same in June 2012

Shrub Height



Shrub Cover



Control

Light Browse

Heavy Browse

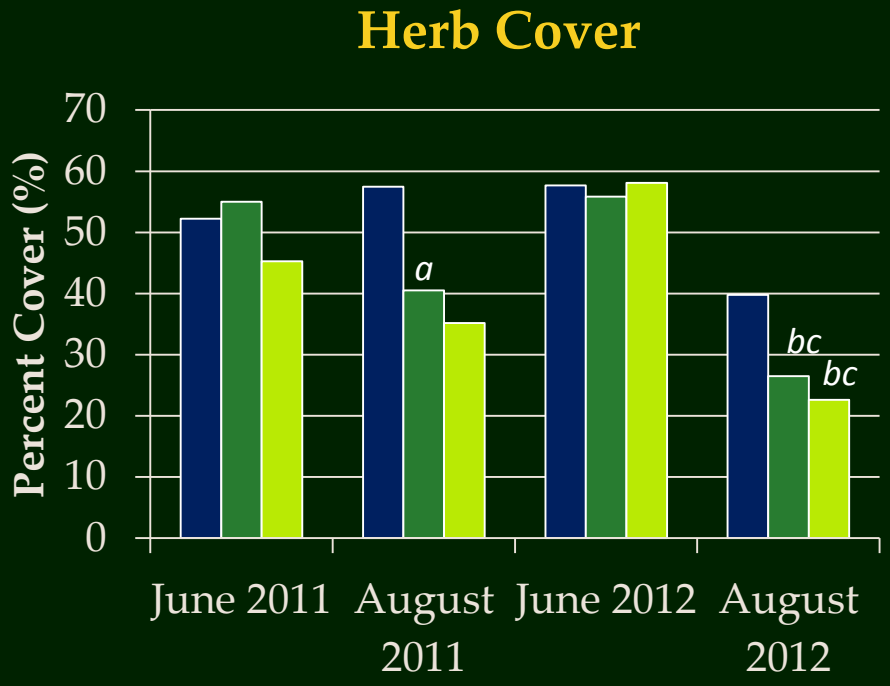
Herbaceous Results

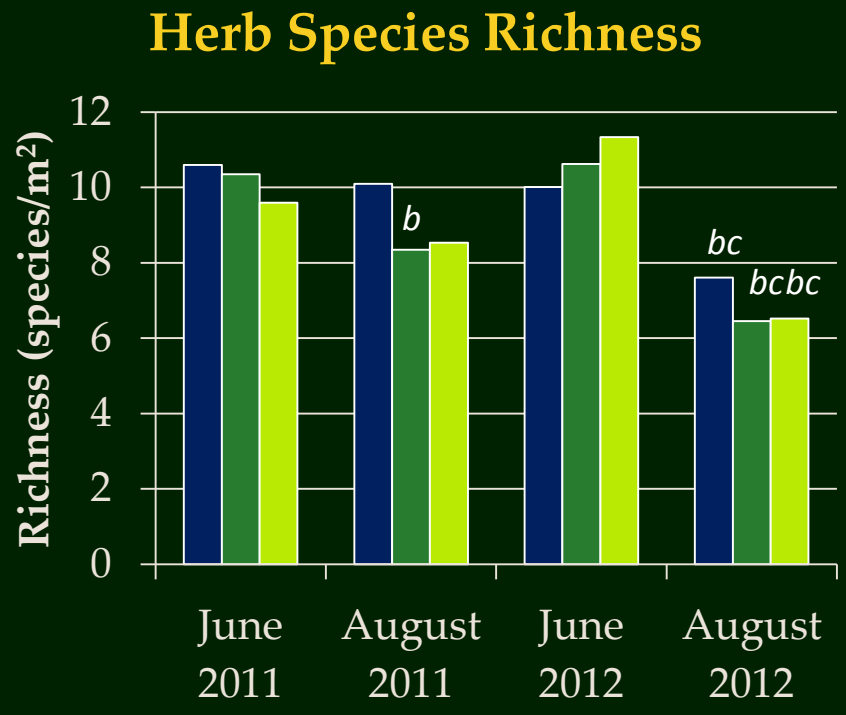
$p < 0.05$

a = difference from control

b = difference from same in June 2011

c = difference from same in June 2012





Control

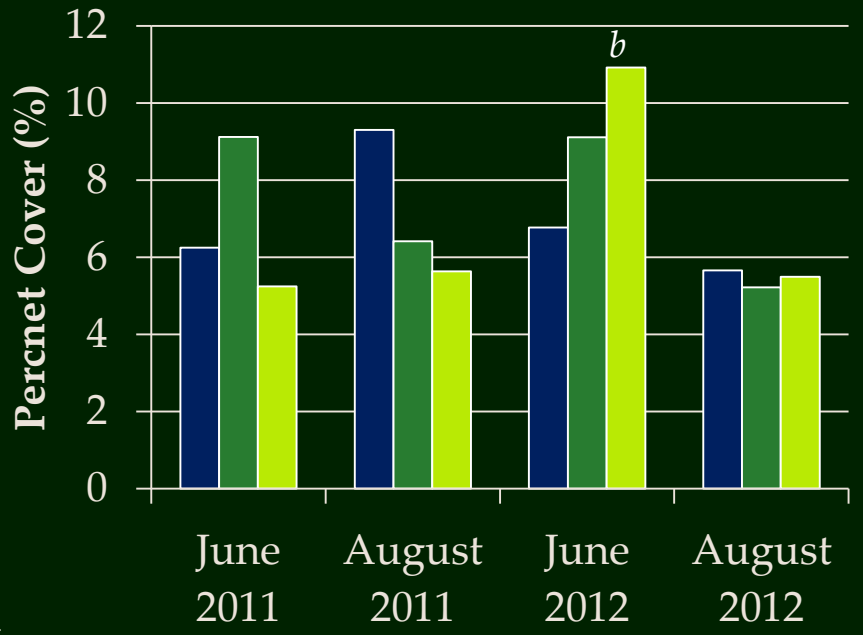
Light Browse

Heavy Browse

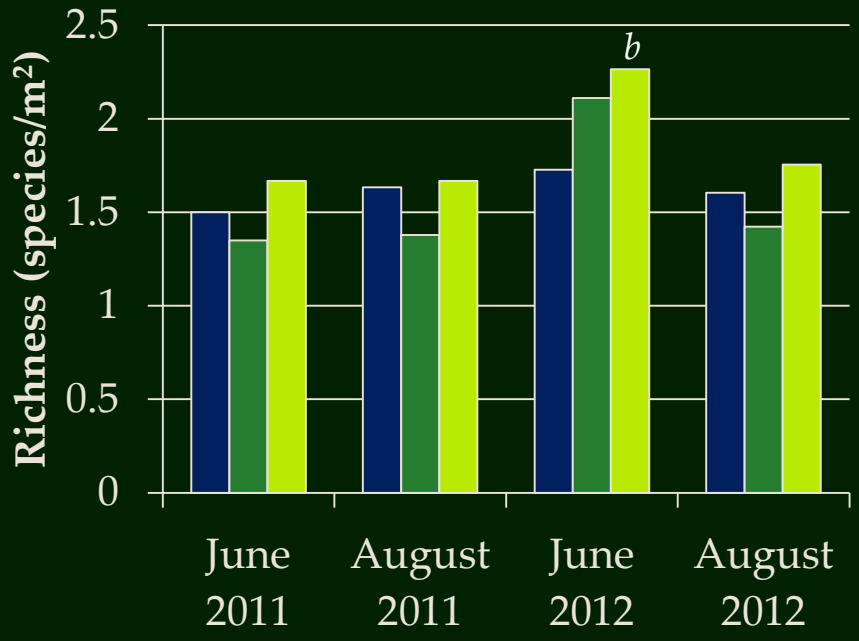
Herbaceous Results

$p < 0.05$
a = difference from control
b = difference from June 2011
c = difference from June 2012

Sun-Favoring Cover



Sun-Favoring Richness



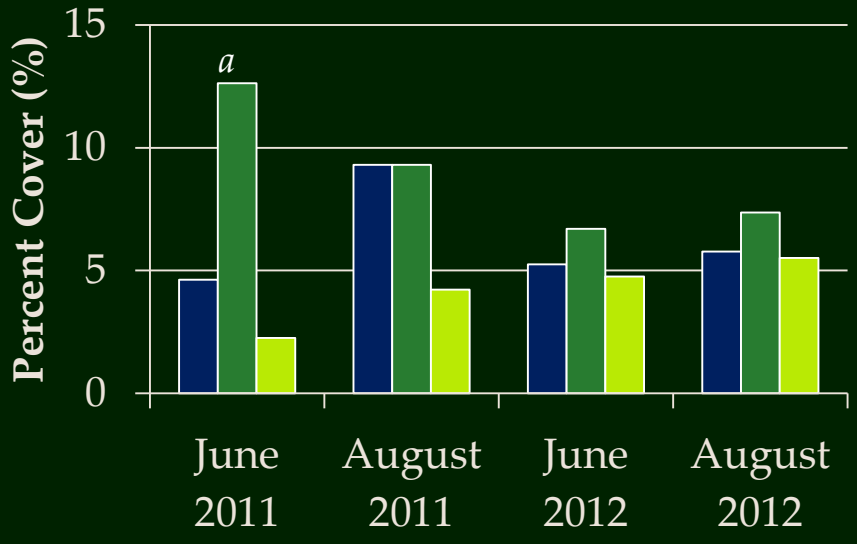
Control
Light Browse
Heavy Browse

Grasses and Sedges

$p < 0.05$
a = difference from control
b = difference from June 2011
c = difference from June 2012

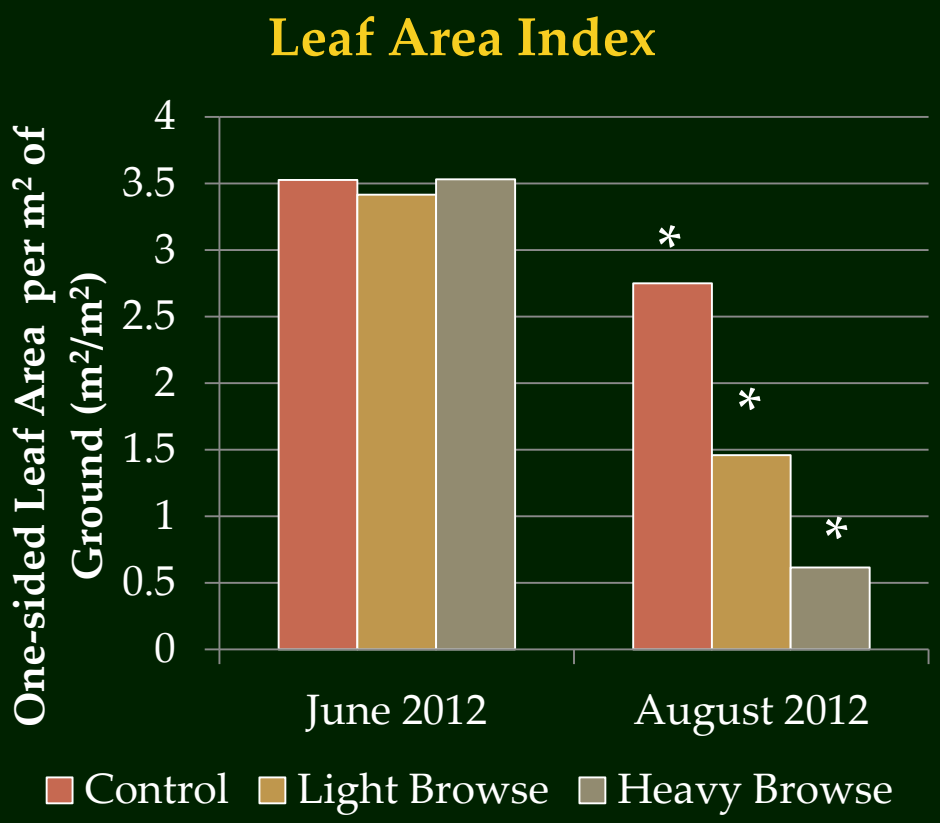
Graminoid Richness

Graminoid Cover



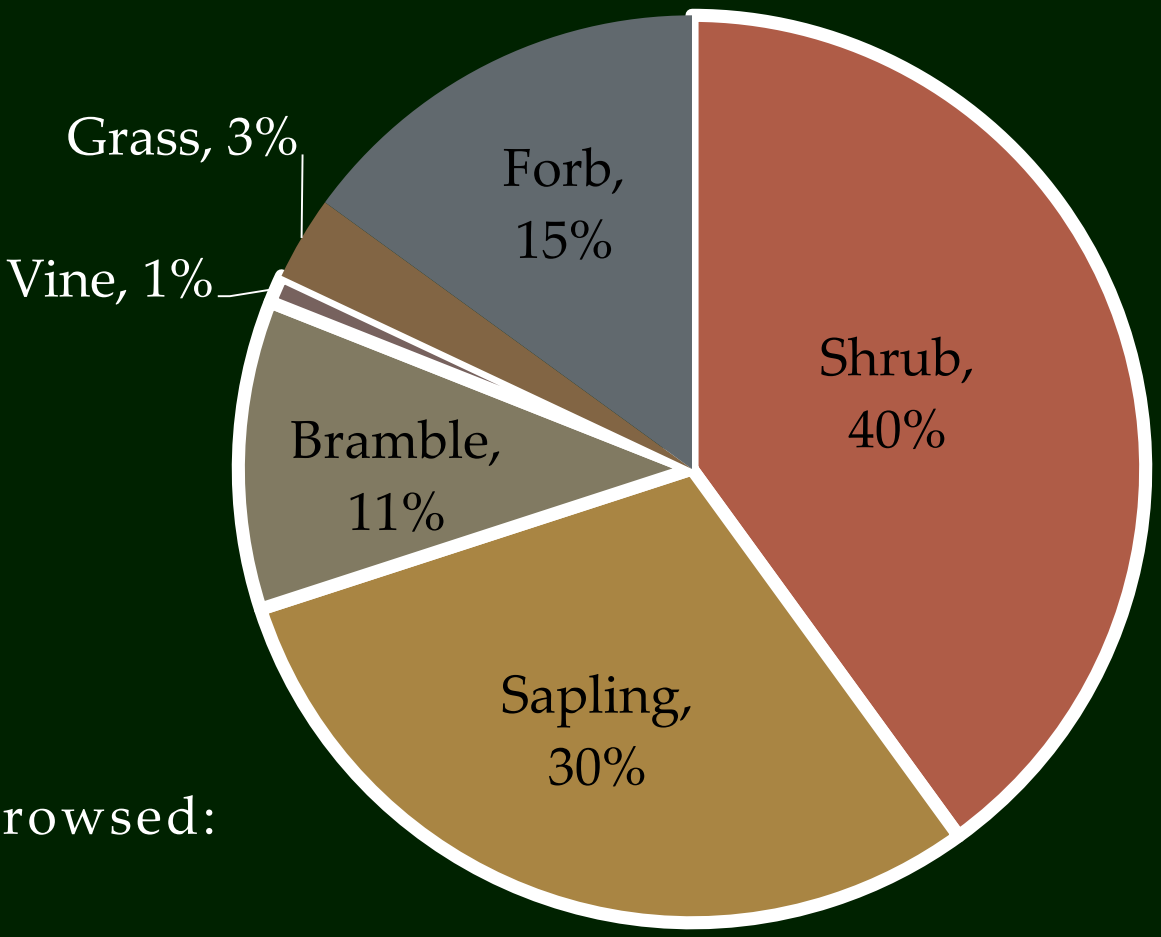
Control
Light Browse
Heavy Browse

LAI, Litter Depth, Compaction, Erosion



- Litter Depth
  - Significant browse effect
  - Decrease in depth in the heavy browse paddocks: 15.7-11.6 cm
- Soil Compaction
  - No significant differences in either year
- Erosion
  - Trampling to bare soil
  - Design flaw, behavior
  - Dry weather

2012 Goat Forage Preference



- 82% Woody spp.
- 18% Herb. spp.

- Most frequently browsed:
- 12.7% Prickly ash
- 10.1% Gray dogwood

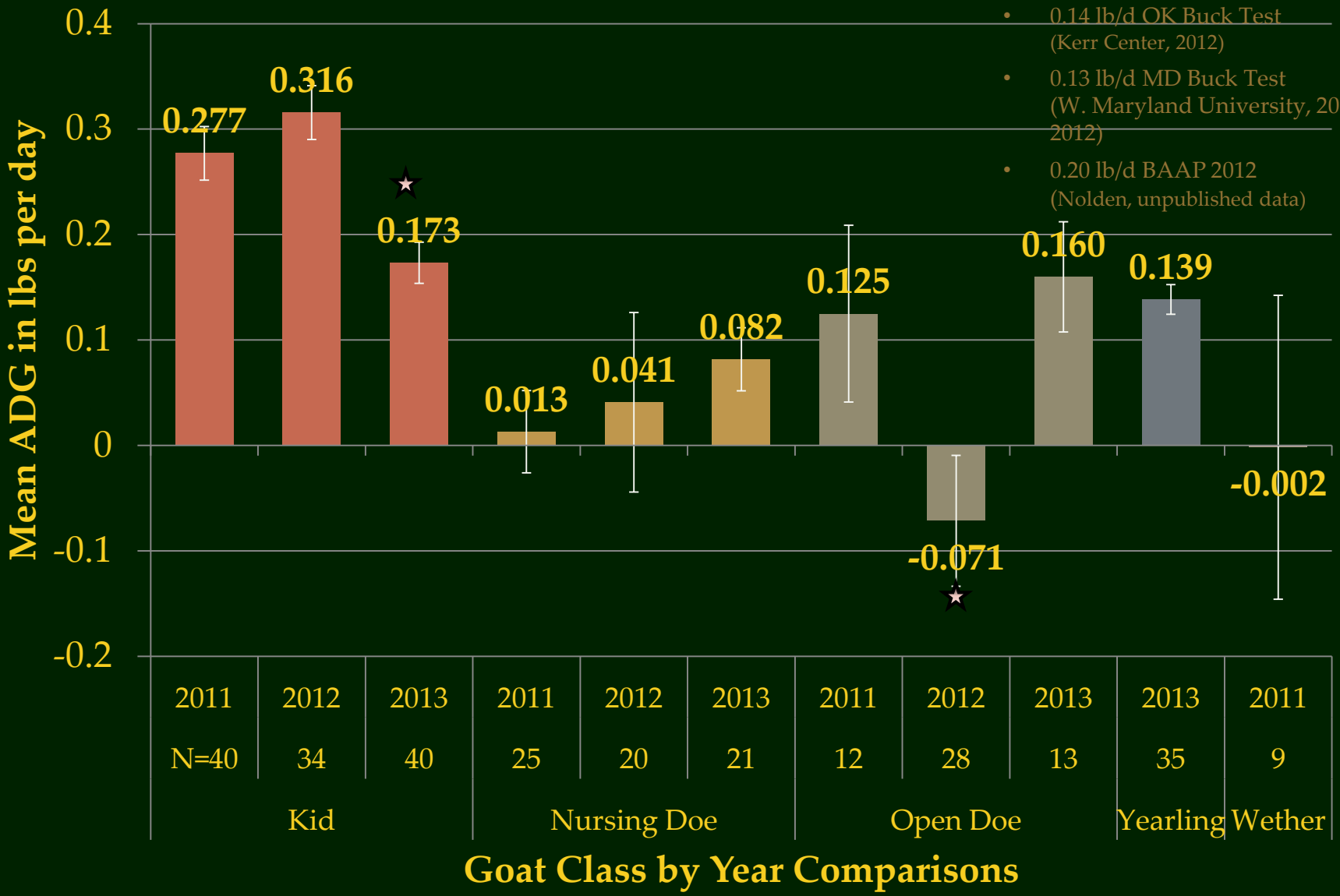
BCS AND FAMACHA

Paired T-Test: Before Browsing and After Browsing Differences in **Body Condition Score**					
	T	DF	P-value	Mean Difference	95% CI of Difference
All Goats, 2 Years	4.2052	192	<.0001	0.24	0.35 to 0.13
2012	0.1163	82	0.9077	0.01	0.19 to 0.22
2013	7.7001	109	<.0001	0.43	0.54 to 0.32

Paired T-Test: Before Browsing and After Browsing Differences in **FAMACHA Score**					
	T	DF	P-value	Mean Difference	95% CI of Difference
All Goats, 3 Years	1.2353	278	0.2177	0.07	0.18 to 0.04
2011	0.5323	85	0.5959	-0.05	0.13 to -0.22
2012	1.8133	82	0.0734	0.19	0.4 to -0.02
2013	0.6949	109	0.4886	0.06	0.25 to -0.12

Nolden et al., unpublished data, Yellowstone Lake Wildlife Area, WDNR, Blanchardville, WI

Average Daily Gain (ADG) by Year and Goat Class, 95% CI



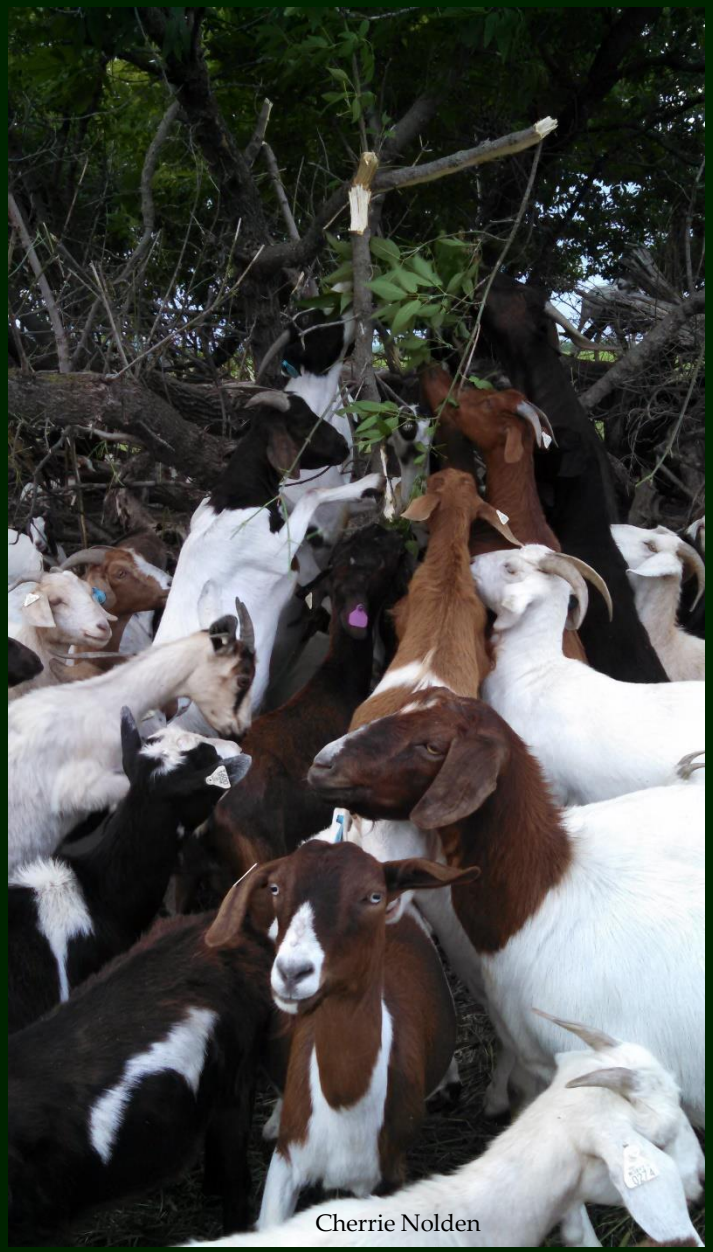
- 0.1-0.4 lb/d is excellent kid growth (Kerr Center, 2012)
- 0.14 lb/d OK Buck Test (Kerr Center, 2012)
- 0.13 lb/d MD Buck Test (W. Maryland University, 2011-2012)
- 0.20 lb/d BAAP 2012 (Nolden, unpublished data)

Conclusions

- Goat browsing reduces shrub layer height and cover
  - Light levels increase
  - Sun loving plants increase
- Goat kid gains are economically viable without grain supplementation
- Soil did not become significantly more compacted
- Litter depth reduced under heavy browsing
- Goat browsing likely can be a very useful management tool for woody plant control
- Longer term research is needed

Acknowledgements

- Grants:
  - Wisconsin Grazing Lands Conservation Initiative (GLCI)
  - North Central Region Sustainable Agriculture Research and Education (NCR-SARE) grant program
  - Animal Welfare Approved (AWA)
  - Center for Integrate Ag Systems (UW-CIAS)
  - Agroecology Program
- Bruce Folley, Wisconsin DNR
- Carl Fredericks, Grass Mapping Enterprises, LLC
- Goat Suppliers
  - 2011: Driftless Land Stewardship, LLC
  - 2012: Vegetation Solutions, LLC
  - 2013: 1dr Acres Farm
- Nicholas Keuler, UW-Madison CALS Statistics Consulting



Cherrie Nolden

QUESTIONS?

Cherrie Nolden

Cherrie Nolden

Cherrie Nolden

Cherrie Nolden

Cherrie Nolden

Cherrie Nolden

BOX ELDER

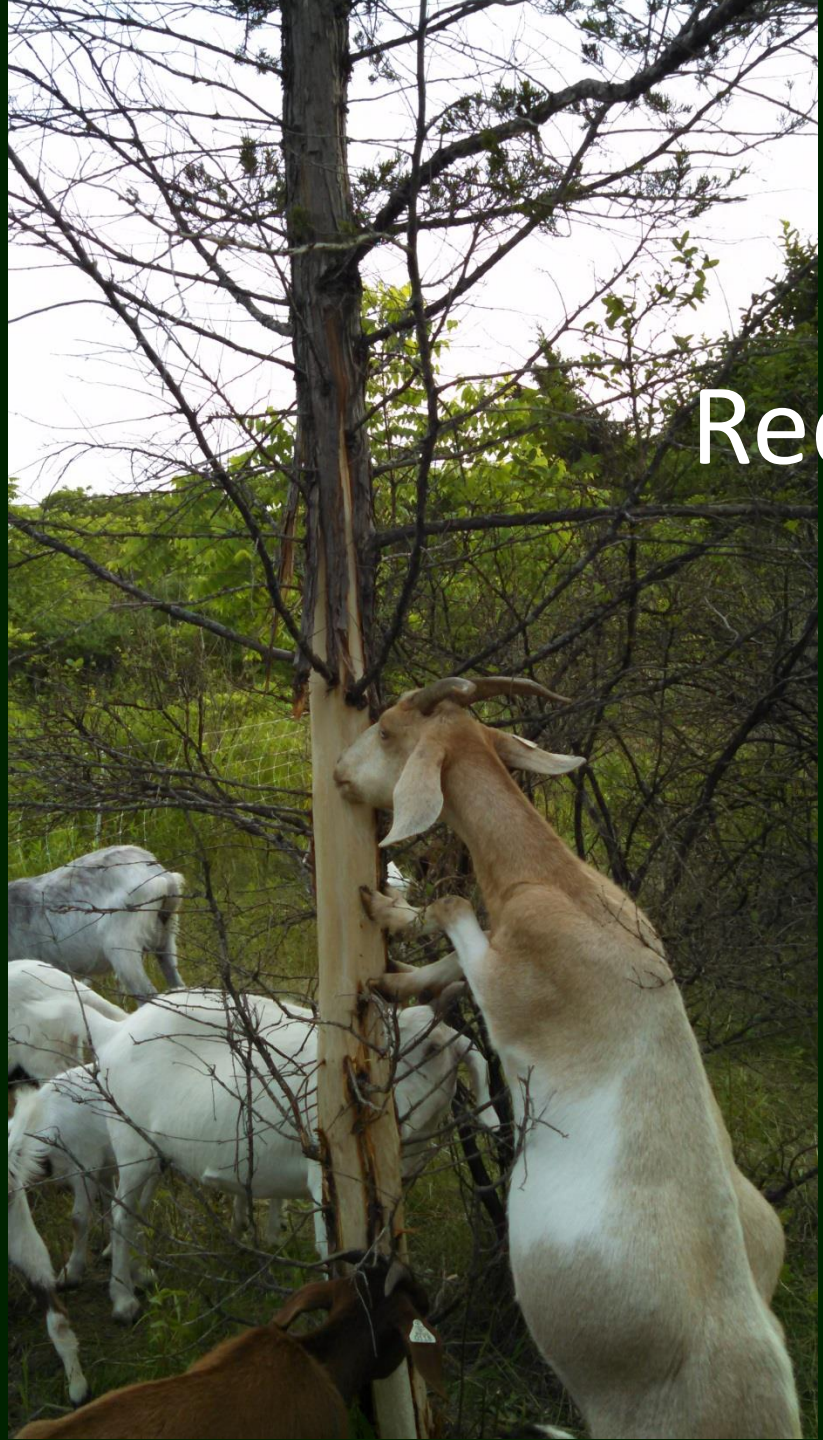
Box Elder

Buckthorn

Cherrie Nolden

Prickly Ash

Red Cedar



Cherrie Nolden

Thistles

Multiflora Rose

Cherrie Nolden

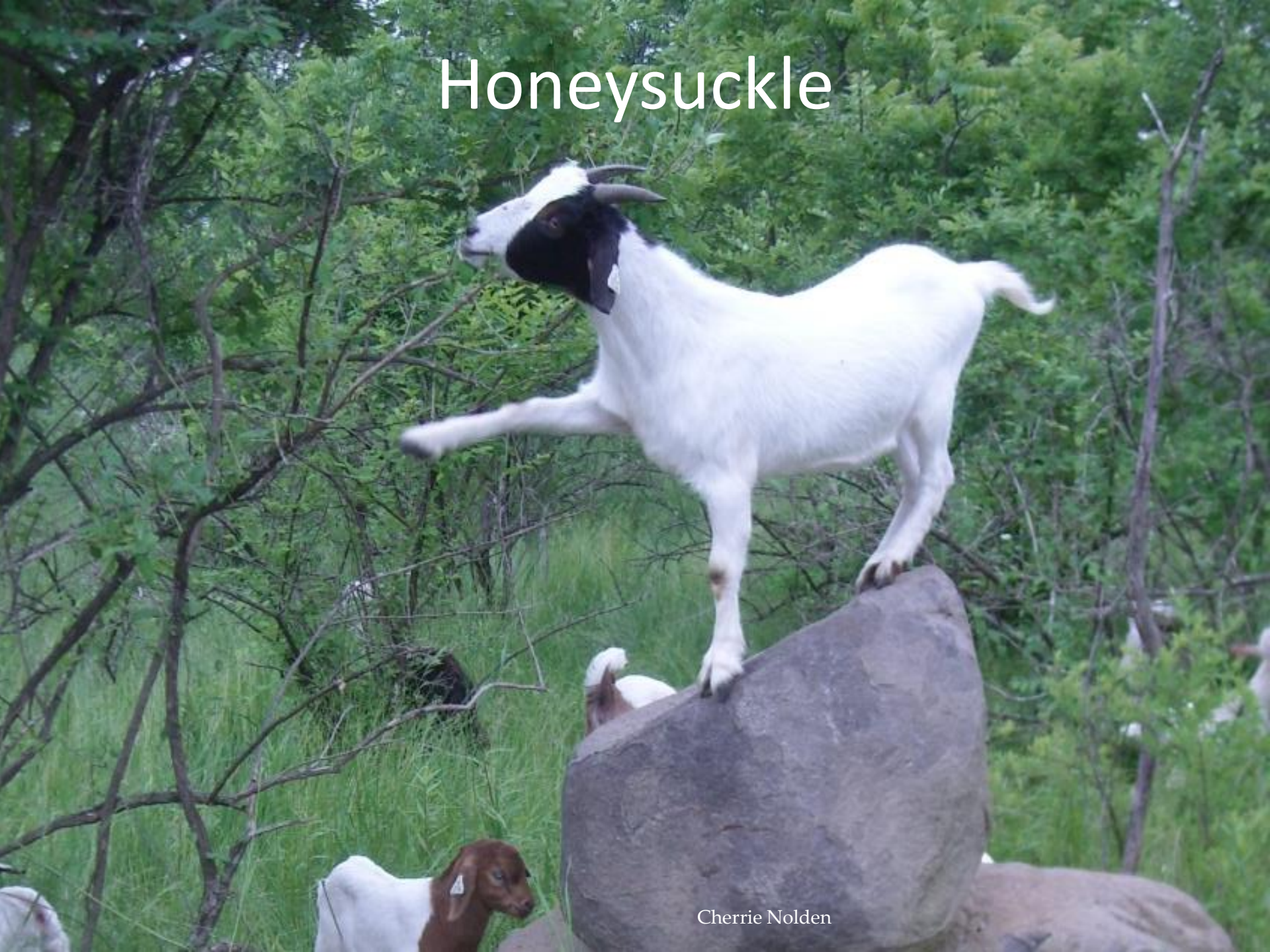
Autumn Olive

Cherrie Nolden

Autumn Olive

Cherrie Nolden

Honeysuckle



Cherrie Nolden

Honeysuckle

Knotweed

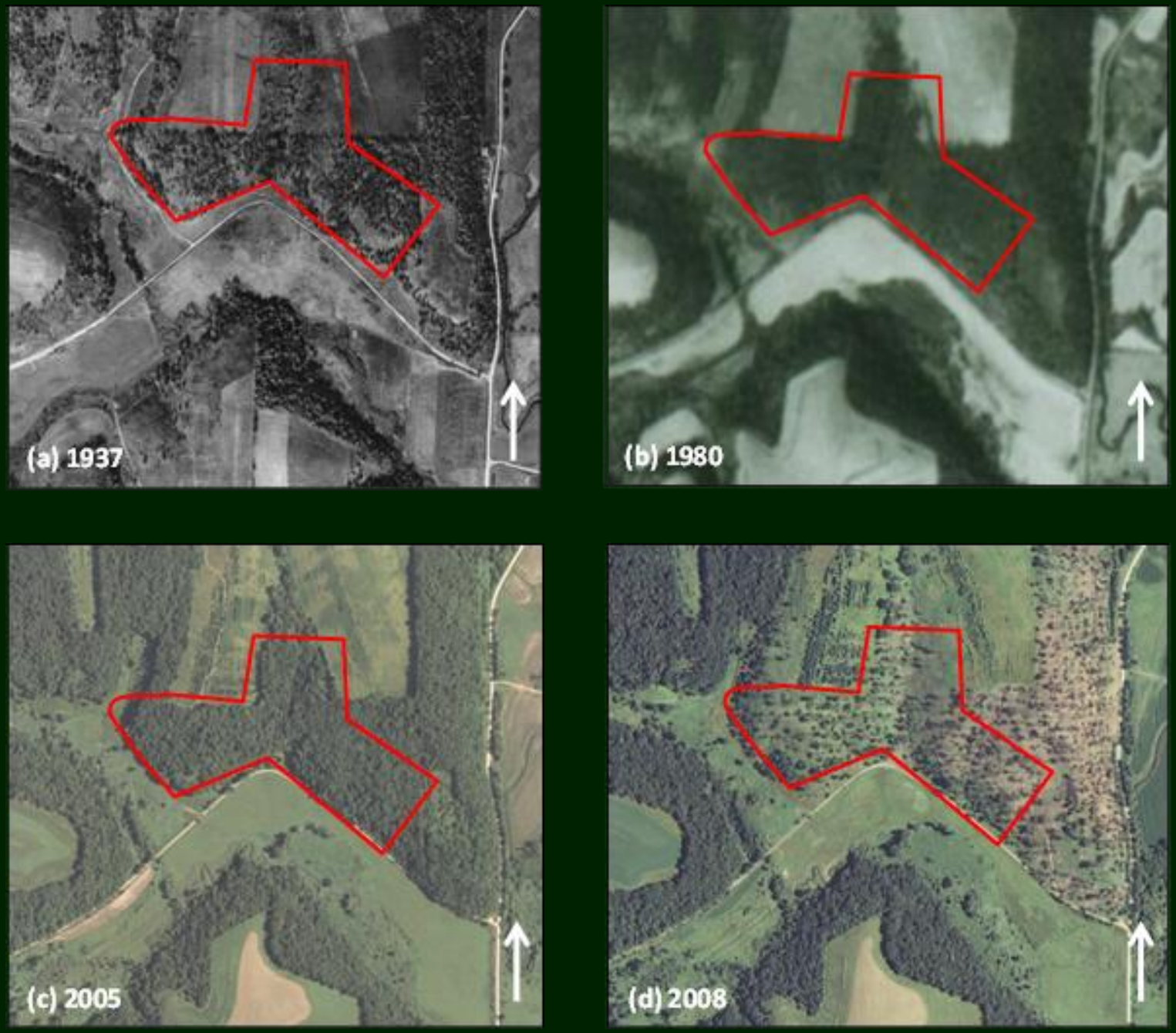
Cherrie Nolden

Goats Loose

Cherrie Nolden

Cherrie Nolden

Cherrie Nolden

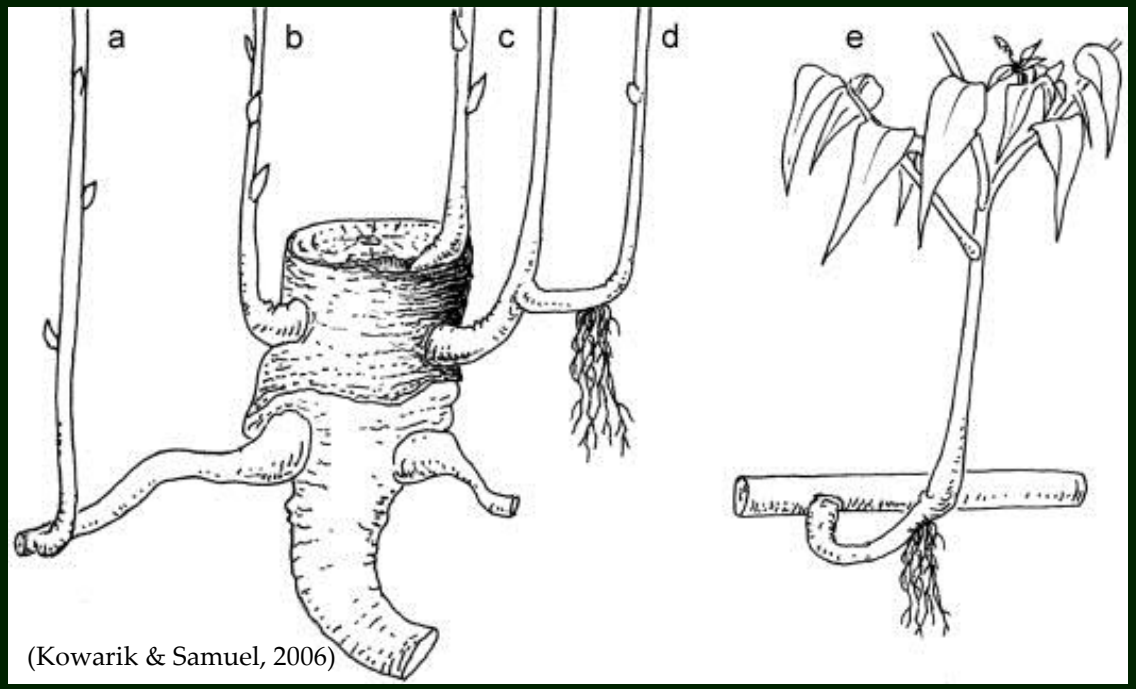


(USDA)

Brush Response to Disturbance

- Root bud response
- Apical dominance
- Single defoliation
- Repeated defoliation

Katie Baumann



(Kowarik & Samuel, 2006)

Steven Edholm

Grazing Resistance Strategies

- Tolerance
  - Mechanical deterrents (awns/spines)
  - Leaf palatability
    - Hairs, wax, silica
    - Tough leaves
    - Toxic to animal, bad taste
  - More vegetation than reproductive tillers
- Avoidance
  - Growing points elevated late
  - Leaf accessibility
    - Short leaves
    - Close to ground or stem
    - High number of stems
    - High amt dead material
  - Growing points low

(Lyons and Hanselka, 2001, adapted)

Mike Zacchino