What is Silvopasture?

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Agroforestry Practices

Silvopasture isn't new

Silvopasture is NOT turning cows loose in the forest

…nor a solo tree in a pasture

Silvopasture = Opportunity

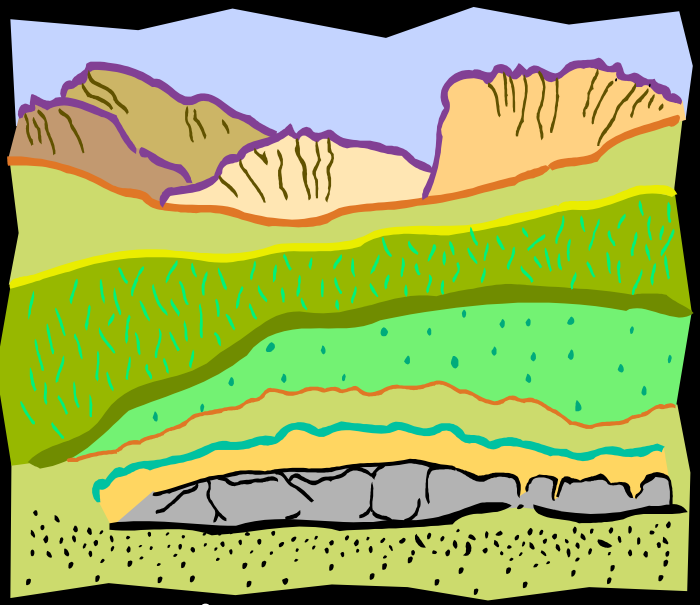
- Sustainable practice
- Intensive, integrated management
  - Trees / Forages / Livestock
- Two economic scales/time frames

Why "Do" Silvopasture?

- Increased forage production
- Improved forage nutritive value
- Improved animal performance
- Production of additional products
- Increased biodiversity
- Greater soil fertility
- Reduced soil erosion
- Improved stream quality

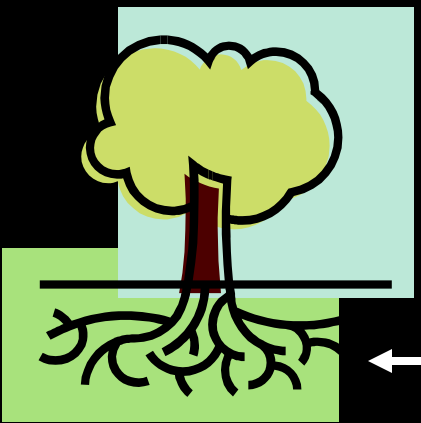
Resources in silvopastures

Light

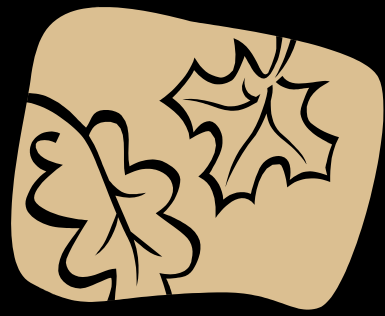


Soil nutrients

Moisture

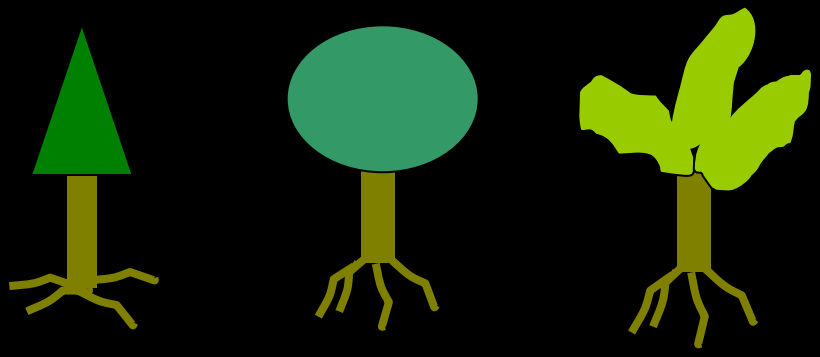


← Nutrient returns →

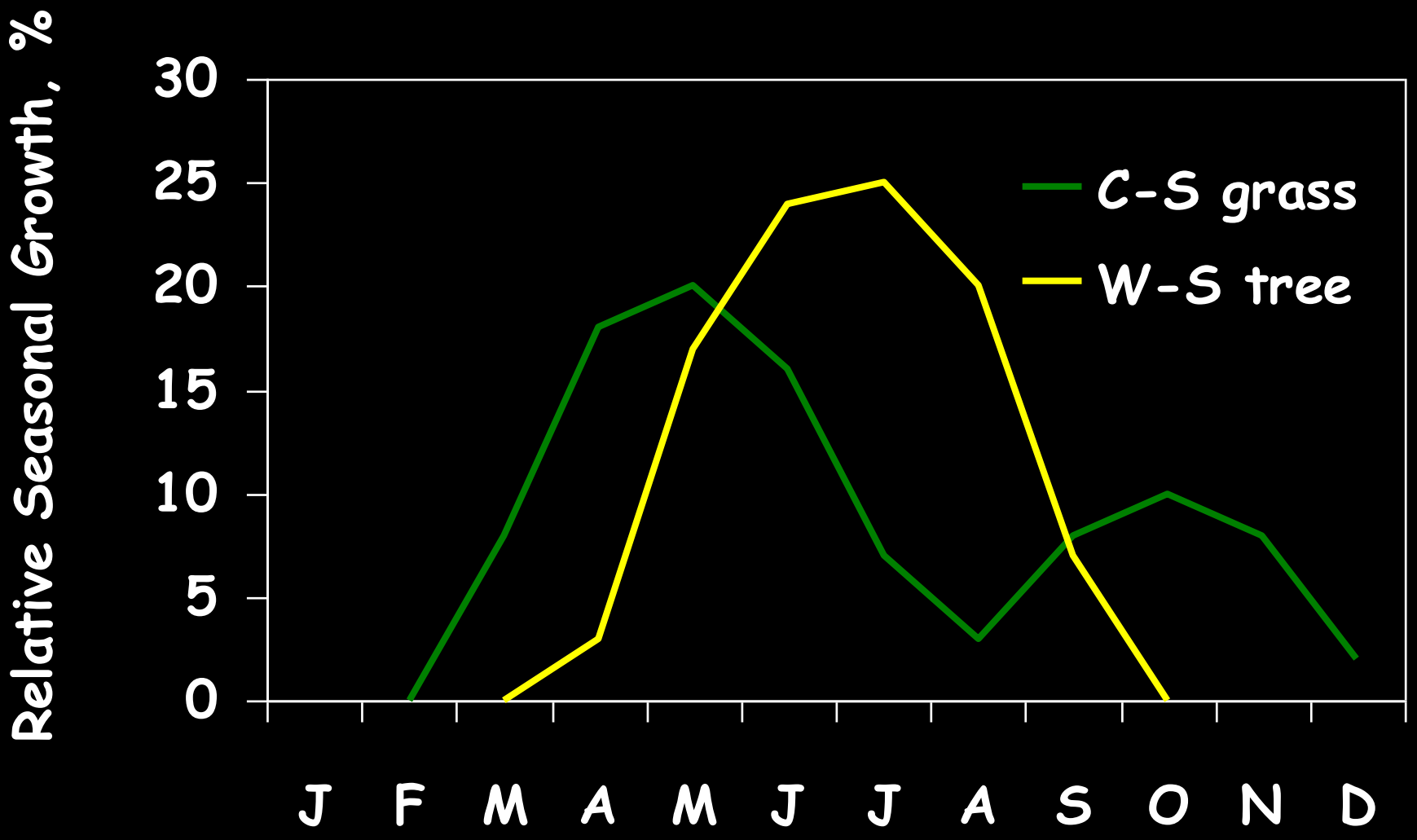


Light

- C_3 leaves: light saturated at 50% full sun
- Leaf growth (at expense of roots) for grasses under reduced light
- Diffuse light used more efficiently than direct beam
- Light quality/quantity differ by tree species

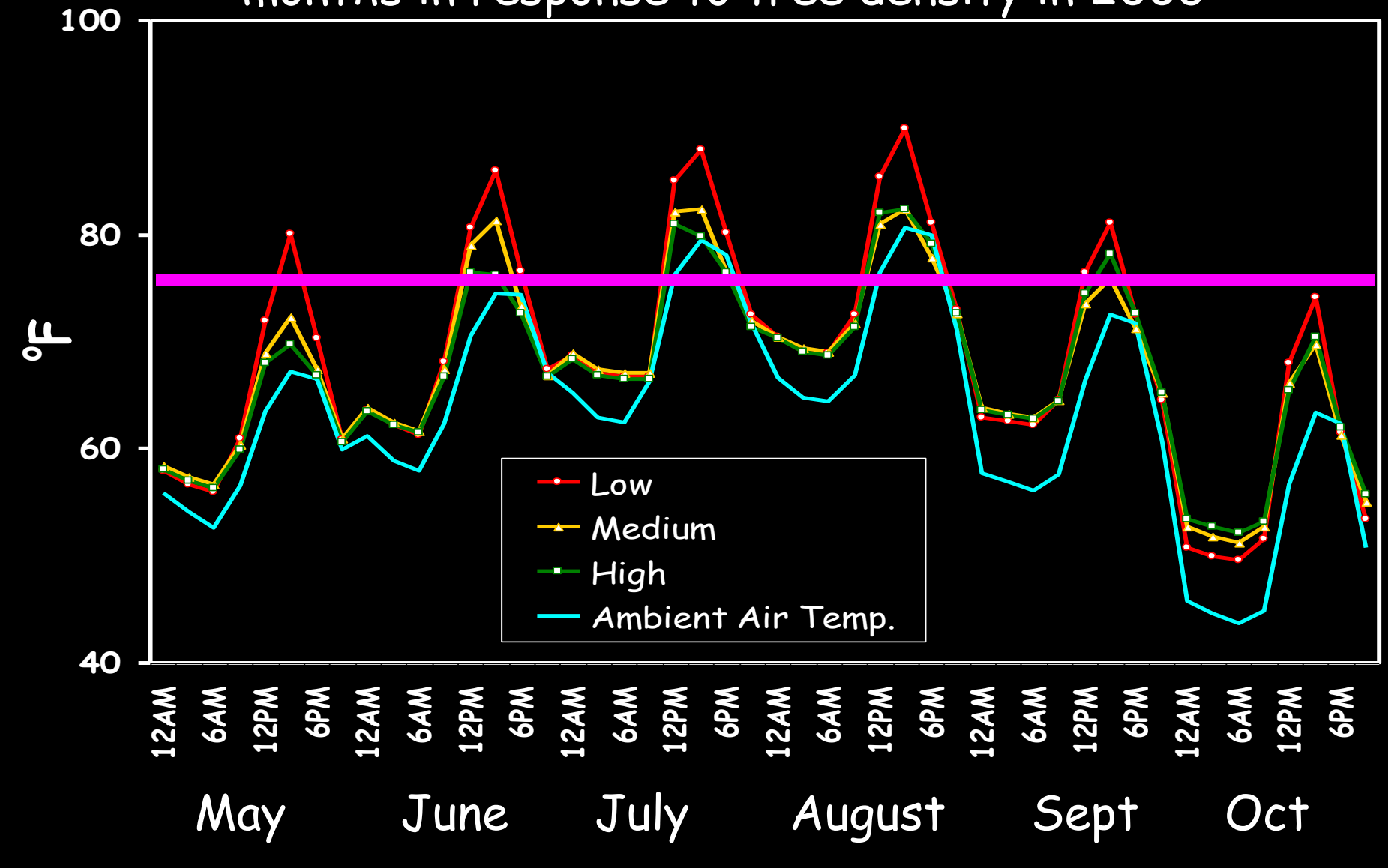


Temporal partitioning



Temperature

Diurnal soil surface temperature averaged within months in response to tree density in 2003



Temp effects on digestibility

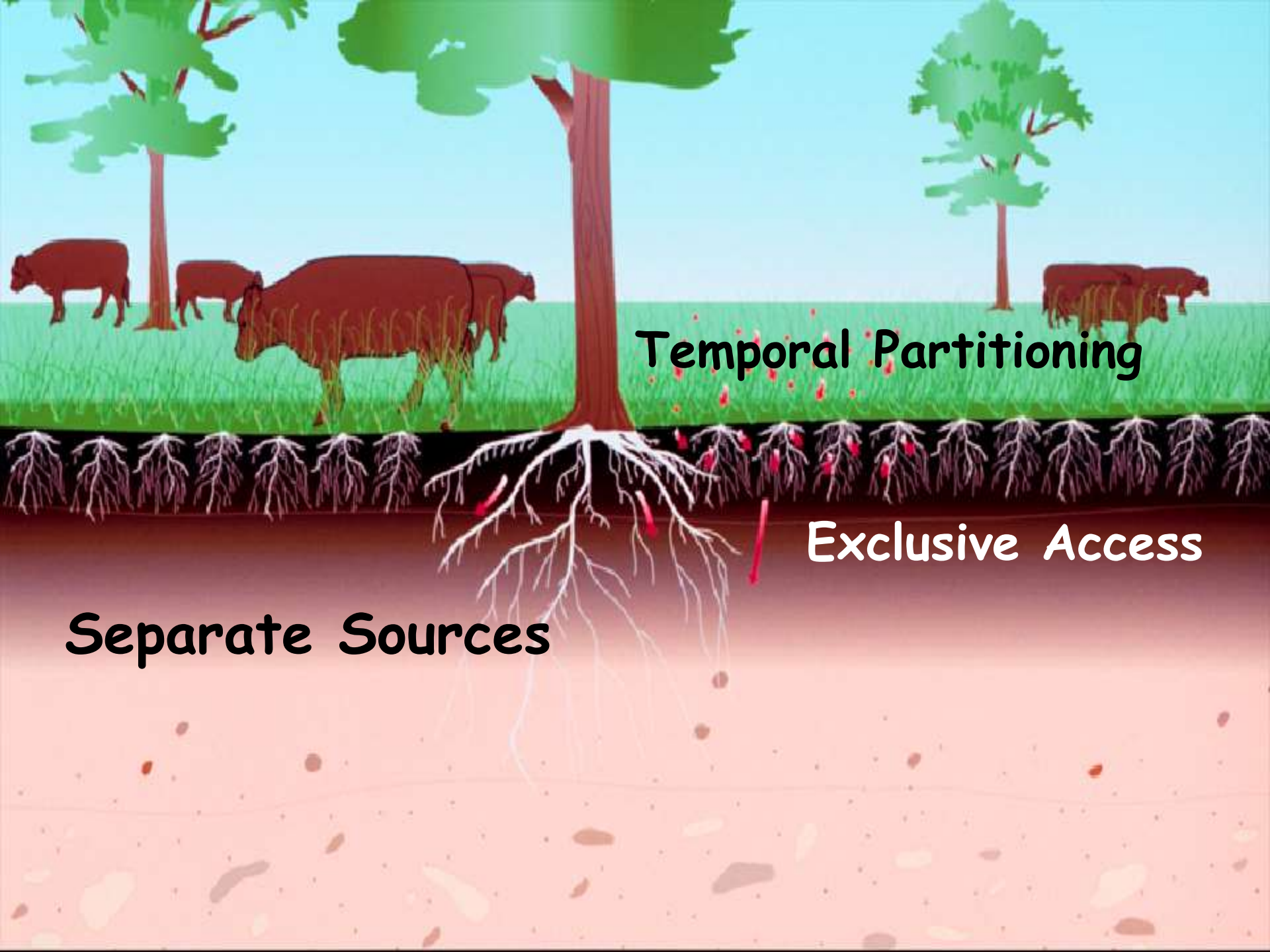
Henderson and Robinson, 1982. Agron. J. 74:943-946

- Yield: positive relation to temp & light
- Digestibility: declines with increased temperature

	Day/Night Temperature, °C			
Grass	35/24	32/21	29/18	26/15
	Digestibility, %			
Bermuda	72	75	77	79
Bahia	81	83	84	86

Moisture

- Deciduous silvopastures: often no soil moisture differences
- Tree shade can reduce evapotranspiration losses
- Response likely varies across the range of soil, site conditions and tree species


Temporal Partitioning
Exclusive Access
Separate Sources

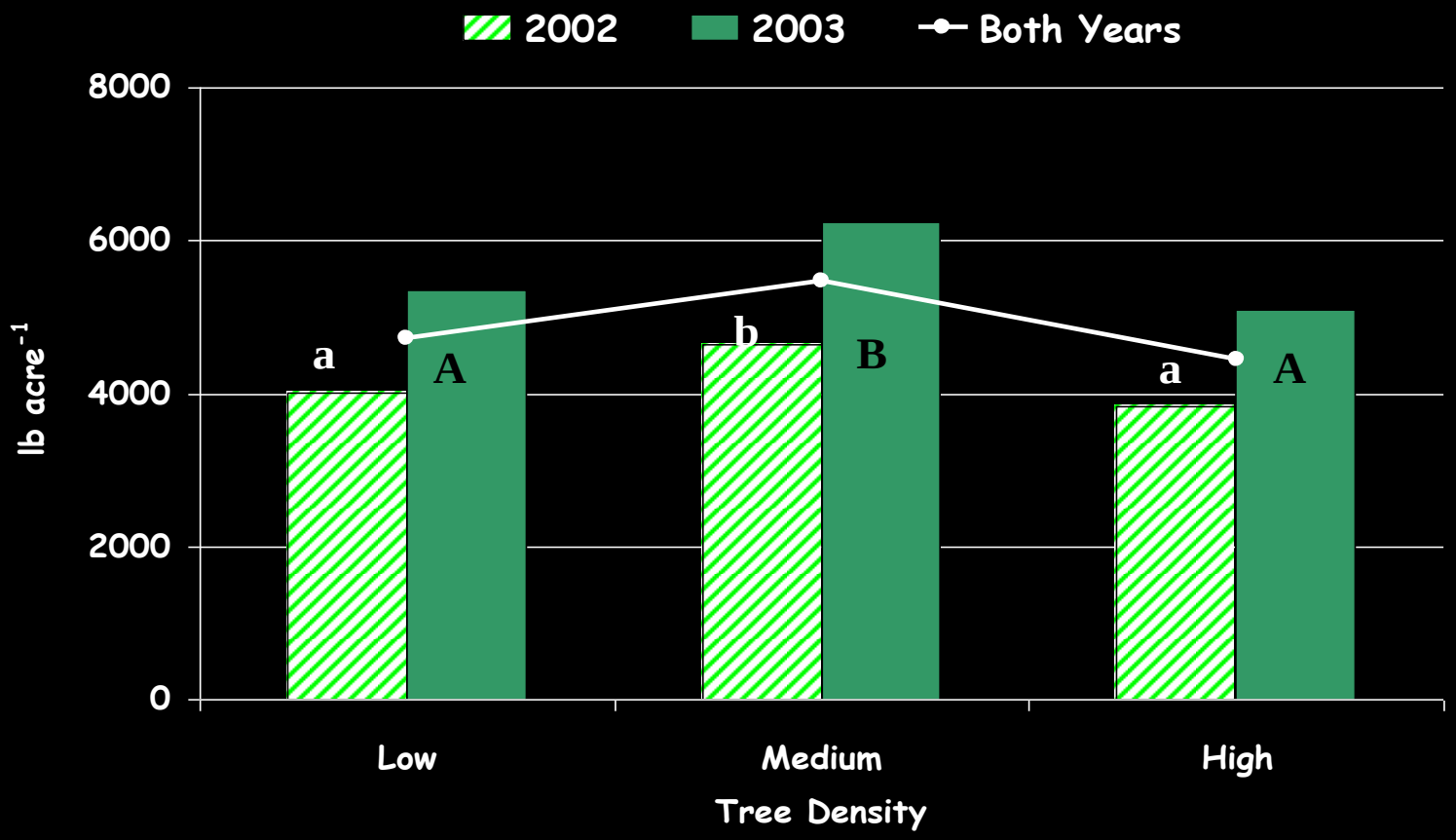
System output implications?

Forage Production

-TN '39: Increased carrying capacity with BW, HL

-OH '42: Greater yield, better forages with BW, BL

-VA '05: Young BW, HL trees …



Forage nutritive value

- Greater mineral concentrations
  (Krueger, 1981; Myers and Robbins, 1991; Buergler et al., 2006)
- Greater CP
  (Smith, 1942; Wilson, 1996)
- Reduced or unchanged NDF
  (Kephart and Buxton, 1993; Buergler et al., 2006)
- Reduced non-structural carbohydrate
  (Belesky, 2004; Buergler et al., 2006)
- Fiber digestibility? – may offset NSC

Livestock production

Livestock production w/ shade

Average daily gain (lb) - 4 year summary			
	Natural shade	Artificial shade	No shade
Cows	1.28**	0.84	-0.04
Calves	1.85**	1.78*	1.17

* P<0.05 when compared to no shade

**P<0.01 when compared to no shade

McDaniel and Roark, 1956

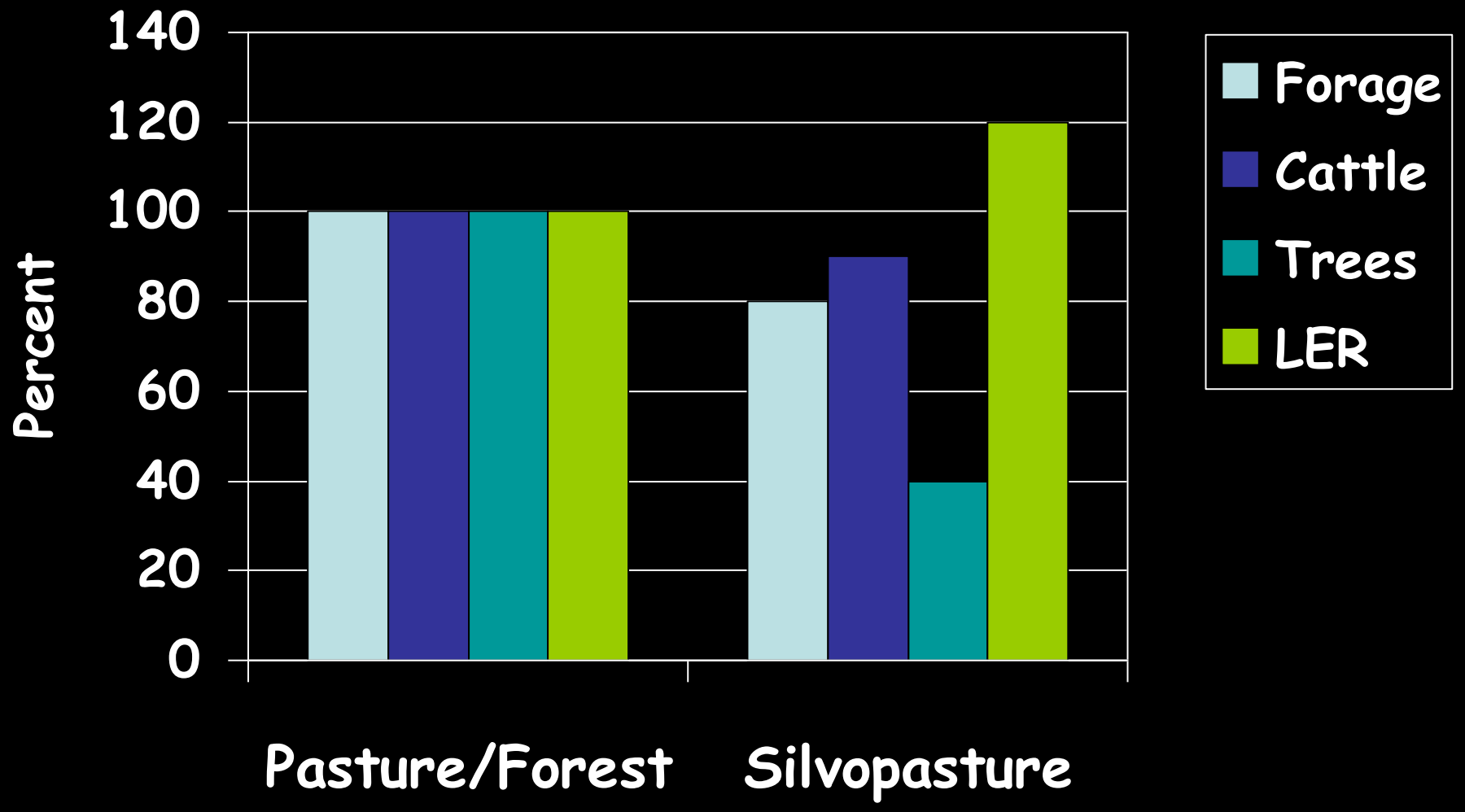
U.Mo. Agroforestry Center
(Kallenbach et al., 2005)

Annual ryegrass in a pine-walnut system

- Reduced seasonal forage yield (20%)
- Forage of greater nutritive value
- No difference in animal gain

Even if all relationships are "negative competitive", silvopastures can be more productive than open pasture

Land Equivalency Ratio



What about conservation functions?

Virginia impaired waters

2012 Assessed Areas

Waterbody Type	Total	Assessed	Attained Use	Impaired[1]
Rivers (miles)	52,255	18,492 (35% of total)	5,347 (29% of assessed)	13,145 (71% of assessed)
Lakes (acres)	116,364	113,678 (98% of total)	19,638 (17% of assessed)	94,041 (83% of assessed)
Estuaries (sq. miles)	2,684	2,268 (85% of total)	139 (6% of assessed)	2,129 (94% of assessed)

1 "Impaired" applies to both EPA Assessment Categories 4 and 5

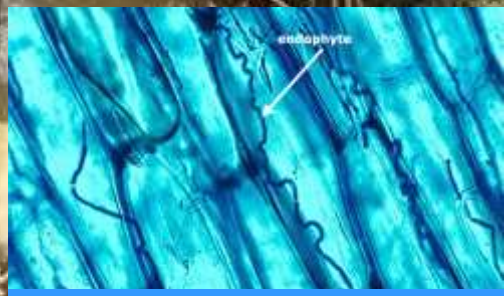
Note: Size adjustments using high resolution hydrography data account for discrepancies from prior cycle.

http://vawatercentralnewsgrouper.wordpress.com/2012/12/05/new-stream-livestock-fencing-funds-and-initiative-announced-by-va-governors-office-on-dec-5-2012/

Fences don't solve fescue toxicosis

Nontoxic

Toxic



http://www.plantmanagementnetwork.org/elements/view.aspx?ID=2028

Replacing TF often not an option

Management considerations for establishing silvopastures

What are the existing resources?

- Environment/Climate
- Tree species: thinning or planting
- Forages and Livestock
- Markets
- Producer ability and management goals
- Social / economic constraints

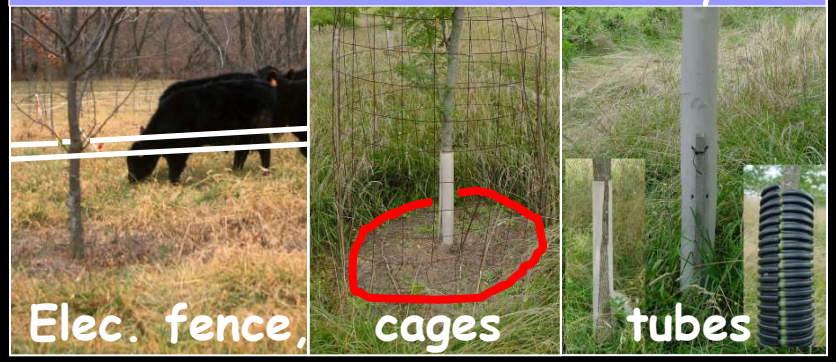
Thinning vs. planting

Larger trees (still require mgmt)
Have to work with what you have

Takes time to reach size
Can choose species, configuration

Renovation opportunity
Tree selection, nutrient input ?s

Protection may be required
Doesn't have to be fancy



Thinning trees - selection criteria

1) market demand (both thinned/"leave" trees)
2) marketable size and timber quality
3) epicormic branching issues
4) invasive? (ailanthus, autumn olive)
5) level of shading (e.g., maples)
6) spatial constraints or infrastructural needs
7) soil compaction
8) labor required

Resource advisors – knowledgeable, collaborative

Companion forages

Grasses

- VA: The usual suspects
  - Arkansas pine data: orchardgrass > fescue
  - Va walnuts: fescue better adapted
- Deep South: W-S grasses okay with pine

Legumes

- Shade tolerance may be an issue
- Clovers, alfalfa sensitive to juglone (walnuts)

Planting trees - selection criteria

1) marketable timber
2) high-quality wood
3) rapid growth
4) deep-rooted morphology
5) drought tolerance
6) additional products (nuts, fodder) and livestock compatibility
7) provision of environmental conservation services
8) labor required
9) rotation length – fxn of:
    1) Producer goals
    2) Land tenure needs/constraints

Planting trees also allows control of spatial arrangement: Rows, spacing, orientation

Planting trees – a few possible species

- Fruit trees – apple, cherry, pear, etc.
- Nut trees – walnut*, pecan*, hickory*, American chestnut?
- Locusts*: black†, honey
- Yellow poplar (moderate shade)
- Oaks – white, northern red (high shade)
- Maple (high shade)
- Pines: Loblolly, Long-or Short-leaf, White

*"Warm-season" tree
†Biological N fixers

Match trees to conditions, needs

Select for site suitability
Rapid growth?
Market value
Multiple products: fruits, nuts, browse

Livestock-tree compatibility

Tender, palatable trees need protection

- Cows more likely to trample
- Small ruminants
  more likely to nibble
- Are wildlife a problem?
- Can site be hayed
  till trees big enough?

'Millwood' honeylocust

Protection methods

Silvopasture management

…requires shifting our thinking in both spatial and temporal domains and demands skills in managing [complexity] rather than reducing complexity…

Garrett et al., '04

Silvopasture management

…requires shifting our thinking in both spatial and temporal domains and demands skills in managing [complexity] rather than reducing complexity… Garrett et al., '04


Trees with pastures can be great
Natural Resources, providing greater
goods and Conservation Services
in livestock systems
SEP 23 2003


Thanks!
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High Yielding Tree
Low Yielding Tree

http://www.telegraph.co.uk/news/worldnews/south[illegible]/uruguay/2349895/Fifty-two-cows-are-killed-after-lightning-h

http://www.lightningsafety.noaa.gov/science/science_ground_currents.htm

http://www.collegehumor.com/picture/2867023/tree-v-cow

Eastern Red Cedar: Challenge?

Or Opportunity?