Silvopasture: Integrating Agroforestry and Grazing Ruminants

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What is Silvopasture?

- Combining timber, livestock and forage production on the same acreage
- Trees provide long-term returns and shade for livestock
- Livestock and forages generate annual income

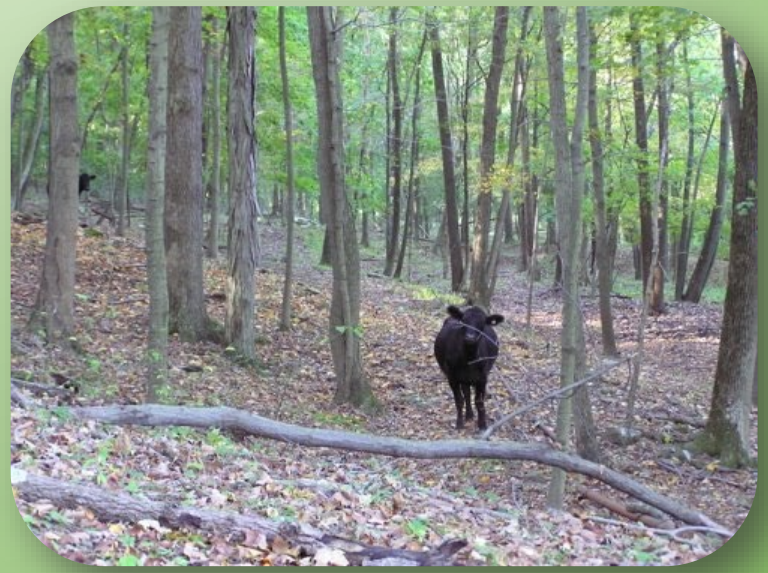
Adding woods to pasture *(or…)*

…Pasture to woods

Credit: Brett Chedzoy

Silvopasture is Not…….

- Woodland grazing
- Forest grazing
- Range grazing



Management System Components

- Trees
- Forages
- Livestock

Benefits of Combining Livestock with Agroforestry Systems

- Stable source of annual cash flow
- Long-term income
- Improved forage quality during summer
- Reduce heat stress in livestock
- Reduce wildfire risk
- Leguminous trees (e.g., black locust; *Gleditsa triacanthos*) can fix N
- Improved wildlife habitat



"Not your grandfather's woodland grazing!"

Credit: Brett Chedzoy

Animal Selection

- Goals for vegetative management
- Characteristics of livestock on hand
- Plant response to grazing by that animal

Goats

- Social – learn from others
- Browsers and grazers
- Can metabolize secondary metabolites
- Challenging to contain
- More agile than sheep
- Susceptible to internal parasites and predators

Sheep

- Grazers and browsers
- Susceptible to internal parasites and predators
- Diet slightly less varied than goats

Cattle

- Grazers- less selective
- Digestive capacity to handle large quantities of low-quality forage
- Large-hoofed animals can cause soil compaction, tree root damage

Multi-species

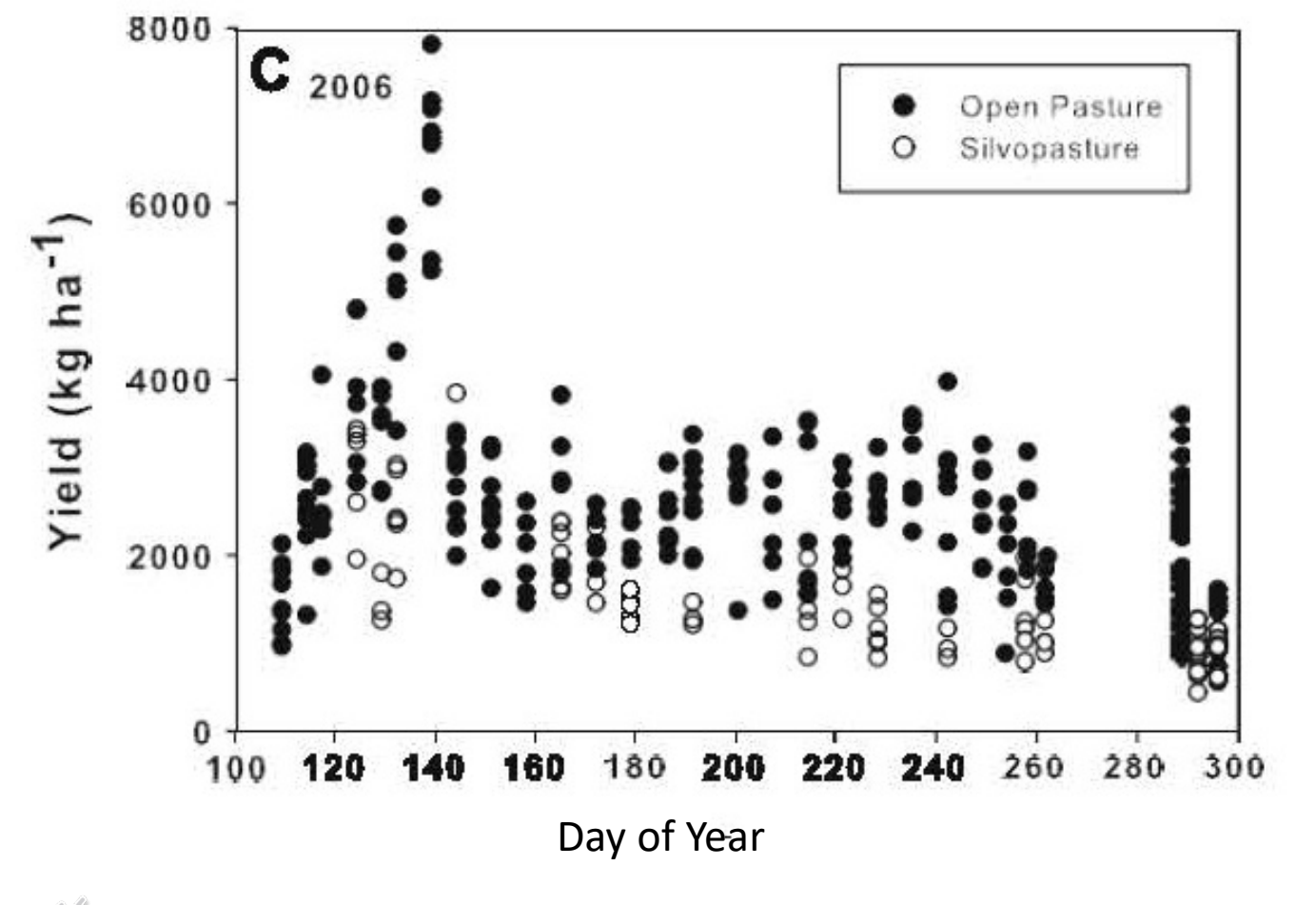
- Compatible grazing habits
- Predator protection?
- Can you manage more than 1 species?

Key Livestock Management Strategies

- Develop comprehensive rotational grazing plan
  - Fencing, rotation schedule, fertilization, placement of water/mineral/supplemental feeding areas
- Monitor trees
  - Browsing, trampling, girdling, rubbing
- Monitor for soil compaction
  - Thin forage stand, tree root damage
- Remove livestock during excessively wet periods

Credit: tatiana Stanton

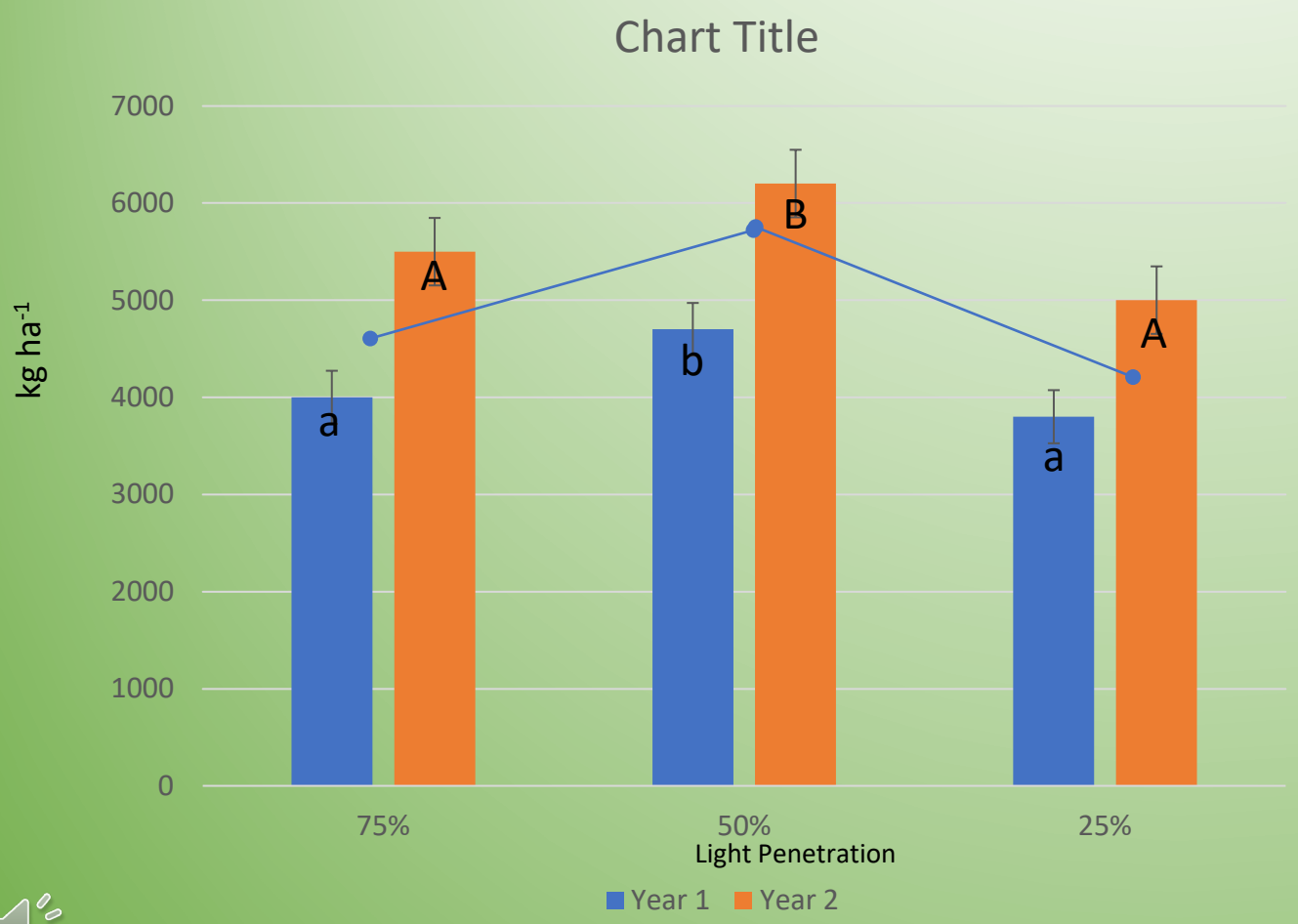
Forage Production in Open Pasture vs. Silvopasture



- Seasonal forage yield in silvopasture was significantly lower than that in open pastures
- Yields were greatest in spring due to temperatures and reduced leaf canopy (deciduous trees)
- Soil amendments (pH, fertility) may help increase forage yield in silvopasture
- Summer forage production and shade are great benefits of silvopasture even if annual forage yield less than open pasture

Feldhake et al., 2010

Forage Production Under Varying Tree Density



- 50% light penetration treatment had greatest forage yield
  - C3 grasses reach saturation at 50% full sun
  - C4 grasses 84%
- Resulted in greatest forage yield
- 75% light penetration increased soil temperature, especially in summer
- 25% light penetration did not allow sufficient sunlight to penetrate

Buergler et al., 2005

Forage Production in Silvopasture Systems

- 40% forage yield increase for newly established tall fescue grown under black walnut trees in Missouri (Garrett and Kurtz, 1983)
- 20% forage yield increase in Virginia (Buergler et al., 2005)
  - More temperate climate
  - Less heat stress on forages
- Response in more moderate climates??????????

Understory was previously dominated by dense invasive shrubs

Credit: Brett Chedzoy

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Credit: Brett Chedzoy

“Living Barns”

Credit: Brett Chedzoy

- *Organic Matter*
  - *Manure*
  - *Hay*
- *Trample Brush*

“Bale Bombs”

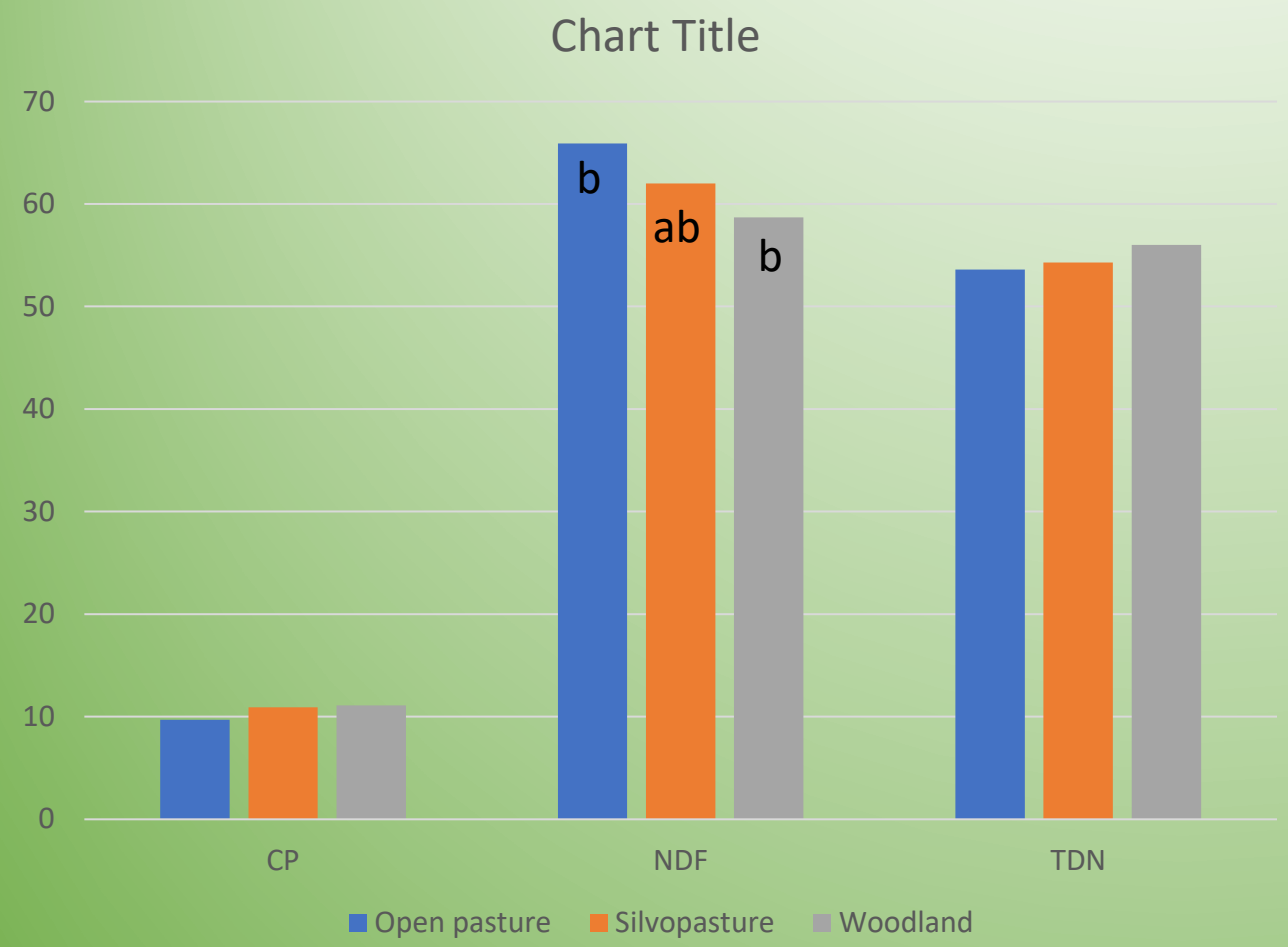
Credit: Brett Chedzoy

Forage Nutritive Value with Increased Tree Density

- Greater mineral concentrations
  - Decreased forage yield would concentrate minerals (Buergler et al., 2005)
- Tendency for greater crude protein (CP)
  - Shaded plants have greater CP (Kephart and Buxton, 1993)
- Reduced neutral detergent fiber (NDF)
  - Decreased light or reduced temperatures can increase NDF (Fales, 1986)
- Reduced non-structural carbohydrates (NSC)
  - Decreased light will reduce photosynthesis (Fales, 1986).

(Buergler et al., 2006)

Forage Quality
Open Pasture, Silvopasture, Woodland



- No differences in CP or TDN
- NDF Woodland < Open
  - Decreased forage maturity with shade
  - More forbs

Ford et al., 2017

Heat Stress

- Major reason to ‘put cows in the woods’
- Temperature, humidity, solar radiation, wind
- TMZ Heat gain = heat loss

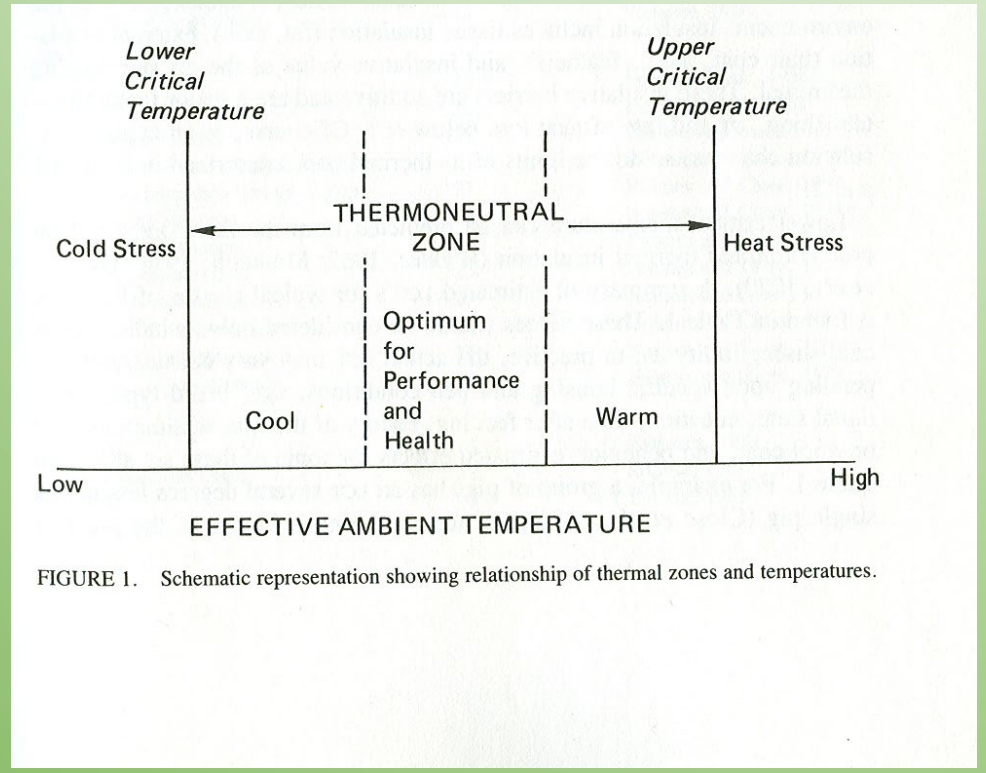
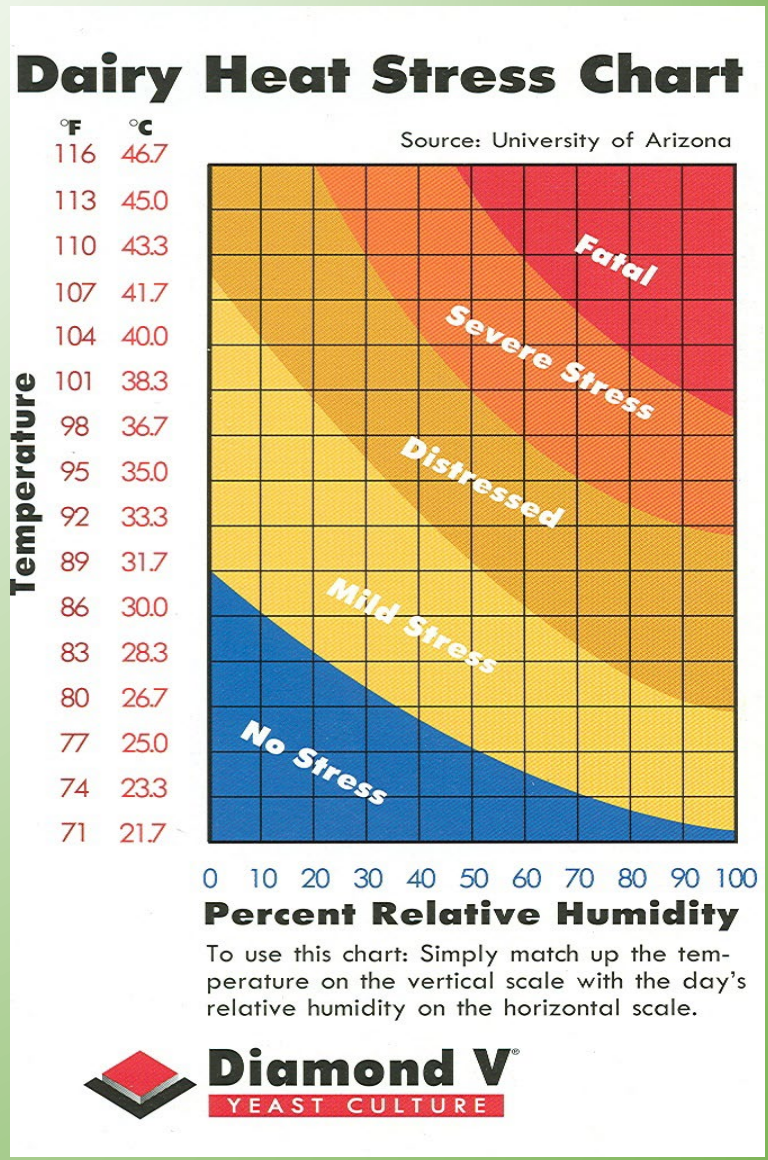
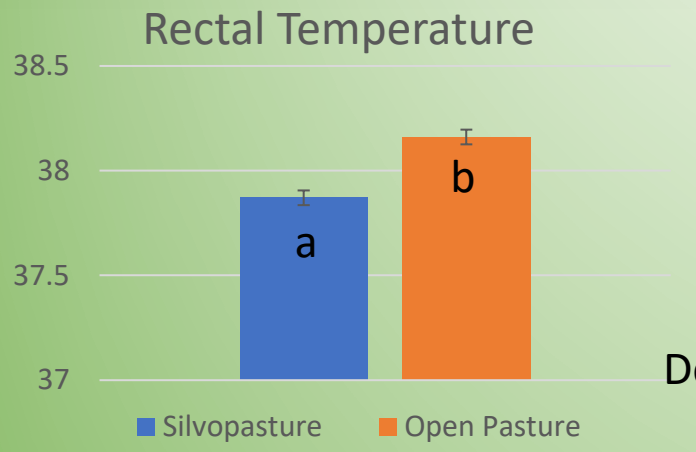


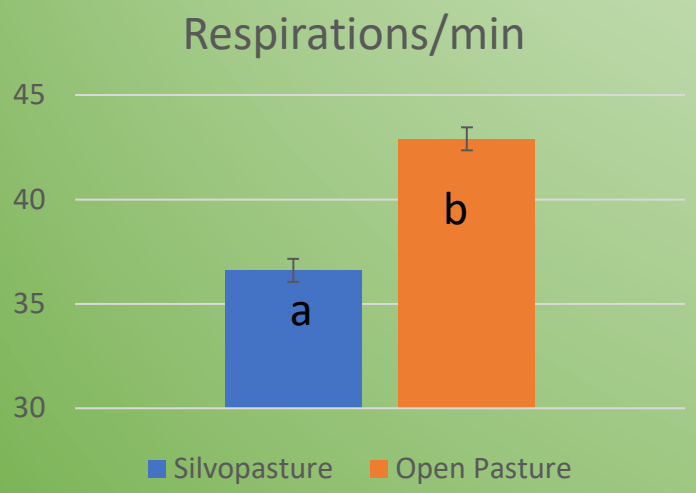
FIGURE 1. Schematic representation showing relationship of thermal zones and temperatures.



Heat Stress Response in Jersey Cows to Open Pasture or Silvopasture

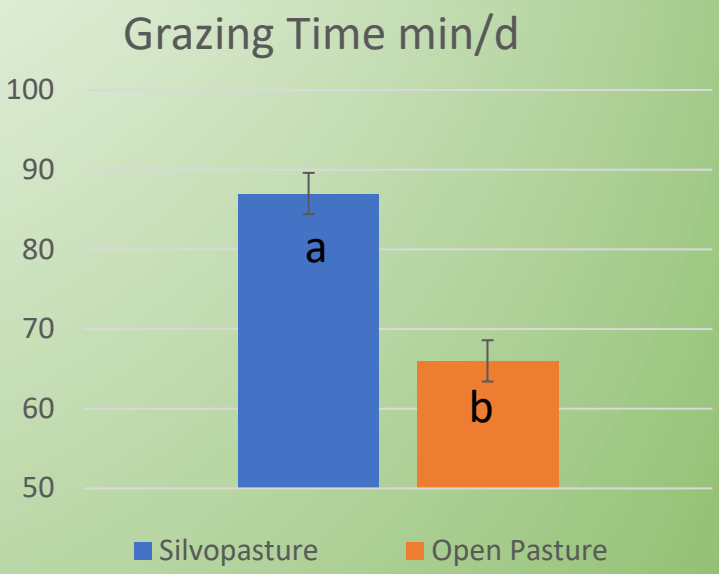


Decreased RT and respirations in silvopasture



Increased GT in silvopasture at night

Linked to ↑ internal blood flow and digestion

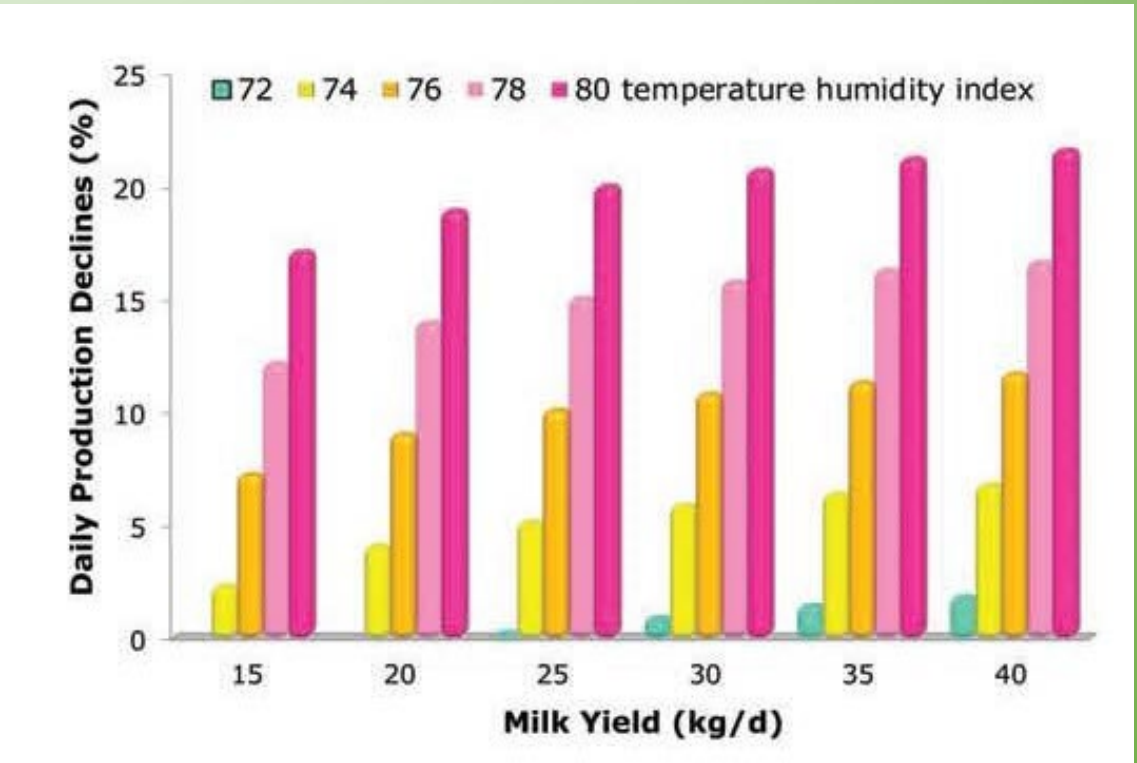


- No milk production data
- Heat stress can result in 15-40% decrease in milk production (West, 2003)

Adapted from Skondieski et al., 2021. Trop. Anim. Health Prod. 53:213

Impacts of Heat Stress on Milk Production

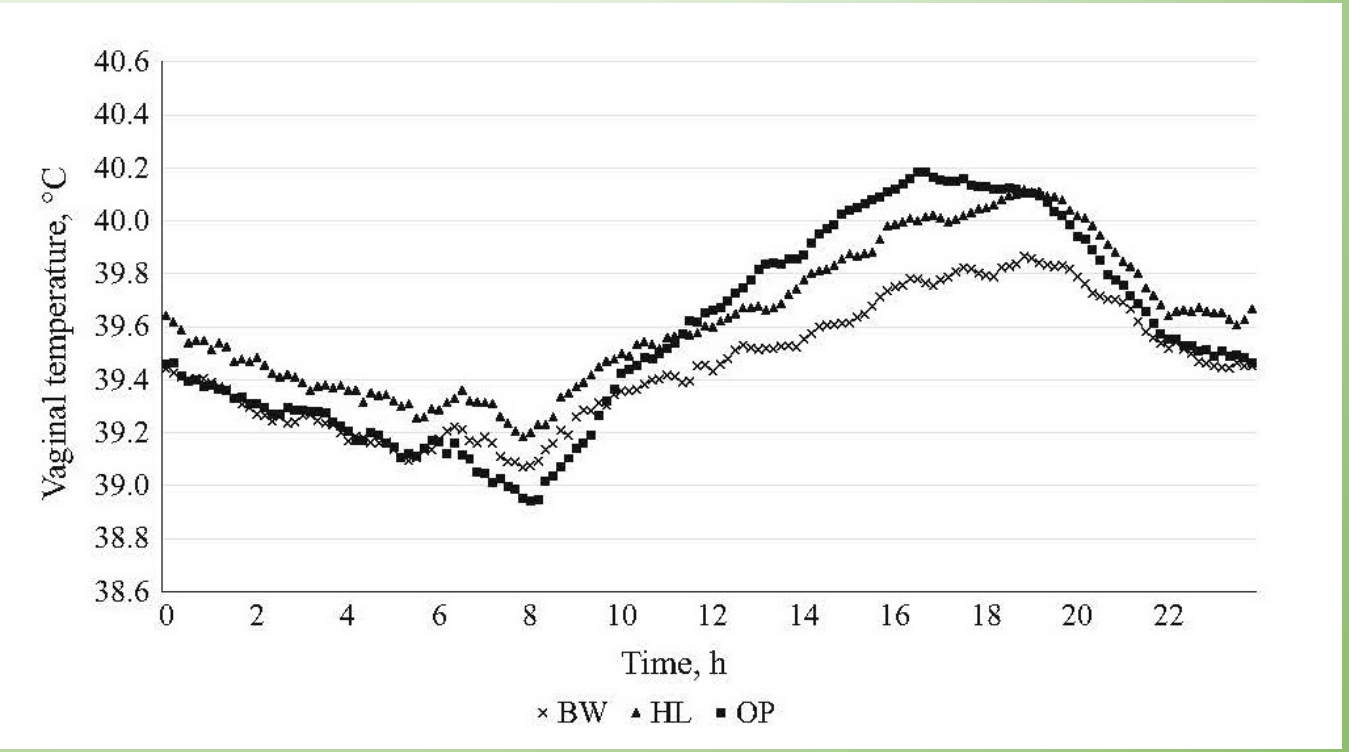
- Dry matter intake decreases (10-25%)
- More energy used to dissipate heat
- Milk production can start to decline in continental dairy breeds at 24º to 27ºC
- Fertility rate can decrease up to 15%
  - Lower conception
  - Embryonic death



Abdullah, 2016; Summer et al., 2019

Diurnal Variation in Mean Vaginal Temperature (VT) of Lambs- Virginia, U.S.

- Lambs in black walnut (BW; *Juglans nigra*) silvopasture had lower VT than open pasture (OP)
  - Honey locust (HL; *Gleditisia triacanthos*) intermediate- more solar radiation
- Lambs in silvopasture had smaller diurnal fluctuations in VT



Adapted from Pent et al., 2021. Agroforest. Syst. 95:21

Silvopastures Can be a Temperature Buffer

- Tree shading can lower air/soil temperature on warm days and increase air/soil temps on cool days (Moreno Marcos et al., 2007).
  - Forages grow earlier in spring and later into autumn
- Reduces diurnal variation in ambient temperature
- Nighttime cooling can be greater in open pastures (Pent et al., 2018)
  - Beneficial during hot periods
  - Detrimental during cold periods

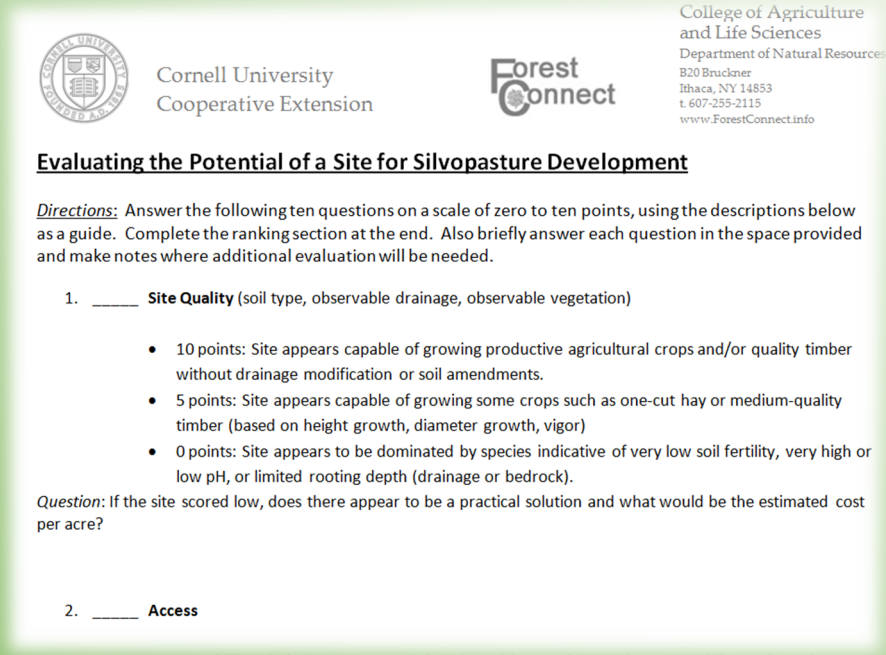
Ecosystem Services

- Wildlife habitat
  - Shelter and food
  - Large game
  - Woodland and grassland bird species
  - Invertebrate populations
  - Pollinators

- Plant communities
- Nutrient cycling
- Reduce wildfire risk

“Guide to Silvopasturing in the Northeast”

and other resources



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Evaluating the Potential of a Site for Silvopasture Development

Directions: Answer the following ten questions on a scale of zero to ten points, using the descriptions below as a guide. Complete the ranking section at the end. Also briefly answer each question in the space provided and make notes where additional evaluation will be needed.

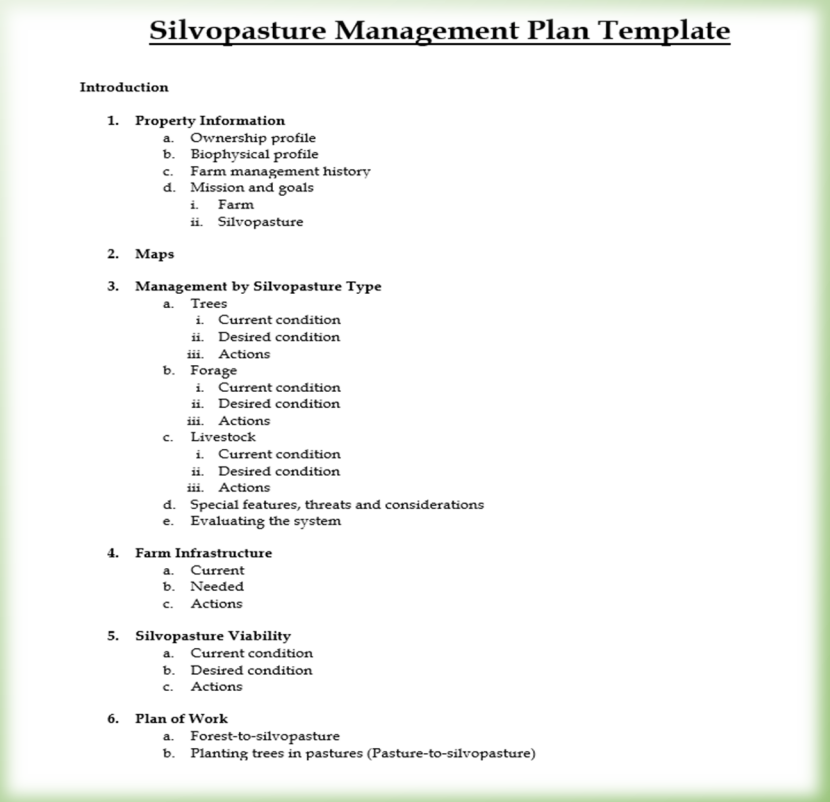
1. _____ **Site Quality** (soil type, observable drainage, observable vegetation)

- 10 points: Site appears capable of growing productive agricultural crops and/or quality timber without drainage modification or soil amendments.
- 5 points: Site appears capable of growing some crops such as one-cut hay or medium-quality timber (based on height growth, diameter growth, vigor)
- 0 points: Site appears to be dominated by species indicative of very low soil fertility, very high or low pH, or limited rooting depth (drainage or bedrock).

Question: If the site scored low, does there appear to be a practical solution and what would be the estimated cost per acre?

2. _____ **Access**

- 10 points: Relatively easy to reach location with materials, equipment and livestock, and to



Silvopasture Management Plan Template

Introduction

1. **Property Information**
   - a. Ownership profile
   - b. Biophysical profile
   - c. Farm management history
   - d. Mission and goals
     - i. Farm
     - ii. Silvopasture
2. **Maps**
3. **Management by Silvopasture Type**
   - a. Trees
     - i. Current condition
     - ii. Desired condition
     - iii. Actions
   - b. Forage
     - i. Current condition
     - ii. Desired condition
     - iii. Actions
   - c. Livestock
     - i. Current condition
     - ii. Desired condition
     - iii. Actions
   - d. Special features, threats and considerations
   - e. Evaluating the system
4. **Farm Infrastructure**
   - a. Current
   - b. Needed
   - c. Actions
5. **Silvopasture Viability**
   - a. Current condition
   - b. Desired condition
   - c. Actions
6. **Plan of Work**
   - a. Forest-to-silvopasture
   - b. Planting trees in pastures (Pasture-to-silvopasture)

available at: www.forestconnect.info

Credit: Brett Chedzoy

The silvopasture forum: www.silvopasture.ning.com

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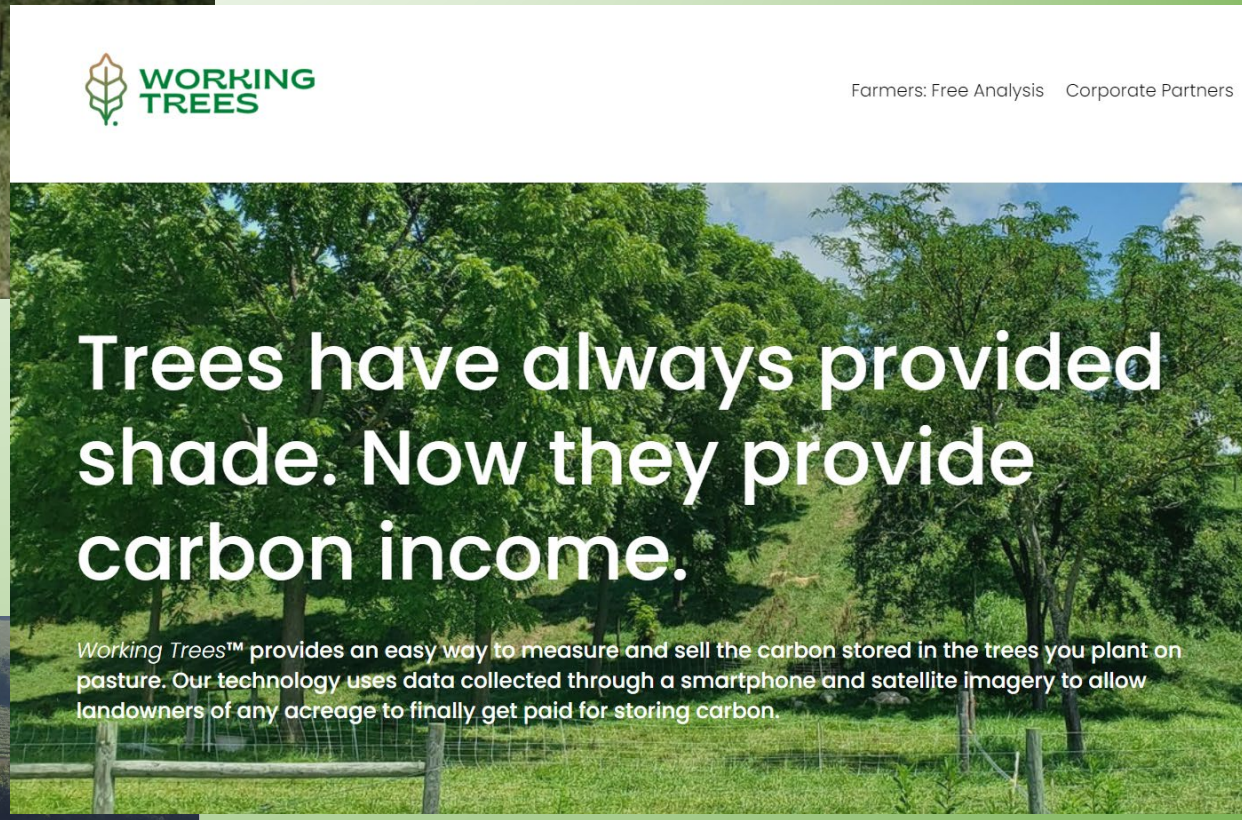

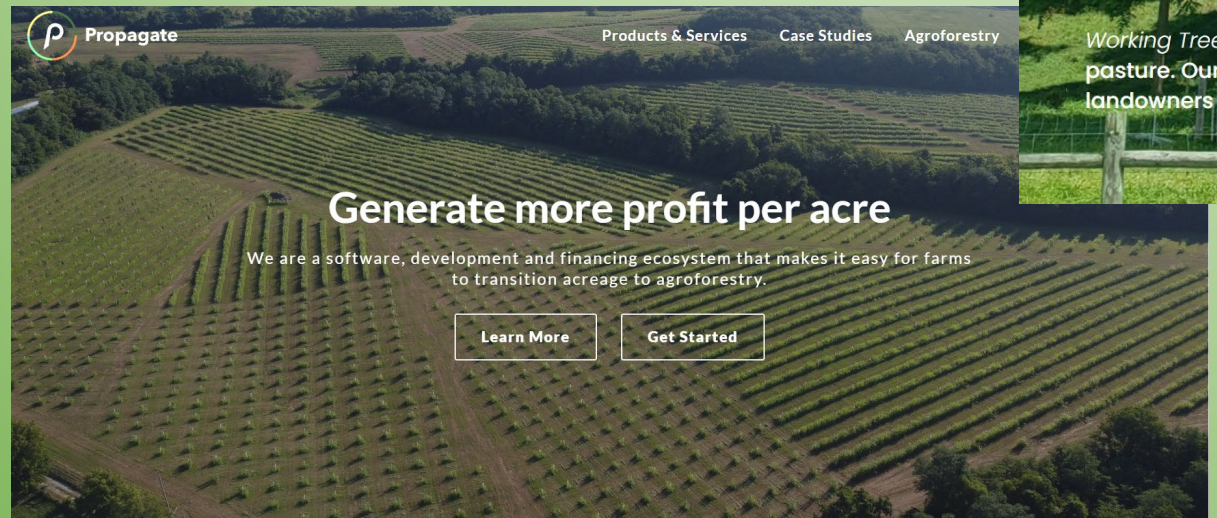

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