Characterization of Light in Forest Stands Following Silvicultural Treatments

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Introduction

• Light
  ▪ Photosynthesis
  ▪ Photosynthetically active radiation (PAR), wavelengths of 400-700 nm

Introduction

• Silviculture and light manipulation
  ▪ Known: cutting increases light
  ▪ However, differences in composition and vertical canopy structure may lead to different amounts of PAR with application of the same silvicultural practice.
Introduction

- Increasing number of ecophysiological studies are leading to quantification of PAR target levels for individual species

Introduction

- Managers need a way of relating specific PAR levels to more practical field measurements such as basal area
- The strength of relationships between PAR and variables such as basal area and canopy cover, may change across forest types and silvicultural treatments

Introduction

- PAR light measurement
  - Instantaneous (short term measurement)
  - Integrated (continuous measurements over long duration)
Introduction

- Temporal variability is the key
- How this variability changes over different forest types and stand structures is not well documented

Introduction

- Ecological impacts of forest management practices
  - Does active forest management simplify composition and structure, and lead to reduced heterogeneity in habitats?

UNCUT STAND SHELTERWOOD WITH RESERVES

- HIGH VERTICAL HETEROGENEITY
- LOW HORIZONTAL HETEROGENEITY
- REDUCED VERTICAL HETEROGENEITY
- INCREASED HORIZONTAL HETEROGENEITY
- TEMPORAL VS. SPATIAL HETEROGENEITY IN LIGHT?
Objectives

• To investigate the hypothesis that implementation of silvicultural practices results in reduced heterogeneity in understory PAR

Objectives

• To compare the degree of spatial and temporal heterogeneity in understory PAR across multiple silvicultural treatments and controls

Objectives

• To compare the strength of relationships between PAR and canopy cover, PAR and basal area, and canopy cover and basal area across multiple silvicultural treatments and controls
Study Site
• Daniel Boone National Forest, KY
Methods
Four silvicultural treatments and controls

- Shelterwood with reserves (10-15 ft²/ac residual basal area to create a two-aged stand)

- Oak-shelterwood (60-75 ft²/ac residual basal area, herbicide to reduce understory stand density)
**Methods**

• Thinning to the B-level of the Gingrich Stocking Chart (tree vigor and crown class will be the basis for marking removals)

• Woodland-thinning (30-50 ft²/ac residual basal area after cutting with prescribed fire for long term maintenance)

• Controls (no treatments)
*Methods – Data Collection*

- Canopy cover: Digital Plant Canopy Imager (CID Inc., Camas, WA)

- Light (PAR): Accupar Ceptometer (Decagon Devices, Pullman, WA)

*Photosynthetically Active Radiation (PAR)*

- Ceptometer in open to calculate % Full PAR
- Values measured in umol m\(^{-2}\)s\(^{-1}\)
Photosynthetically Active Radiation (PAR)

- PAR sampling mid-June, mid-July, and mid-August
- Measurements taken in 2 hour time spans: morning, noon, and afternoon
- Measurements centered around solar noon

Example:
If solar noon = 1:30pm
Morning = 9:30am-11:30am
Noon = 12:30pm-2:30pm
Afternoon = 3:30pm-5:30pm

*1 hour rest period between each time period
**Potential Analysis Techniques**

- Computation and comparison of variances across time periods and treatments

**Potential Analysis Techniques**

- Kriging is synonymous with "optimal prediction" (Journel, A. and C.J. Huijbregts, 1981). It is a method of interpolation, enabling predictions of unknown values from data observed at known locations.

Kriged ground-level gap light index (GLI) spatial patterns in longleaf pine following silvicultural treatments. (Battaglia et al., 2002)
Potential Analysis Techniques

• Investigation of the strength of relationships between PAR, basal area, canopy cover, etc. through regression analysis

Acknowledgements

Dr. David Buckley, UT-FWF
Dr. Stacy Clark, USFS Southern Research Station
Dr. Jason Henning, UT-FWF
Dr. Callie Schweitzer, USFS Southern Research Station

? Please recycle. Enjoy the summer.