Potential Productivity for Spruce Forests of Maine and Eastern Canada

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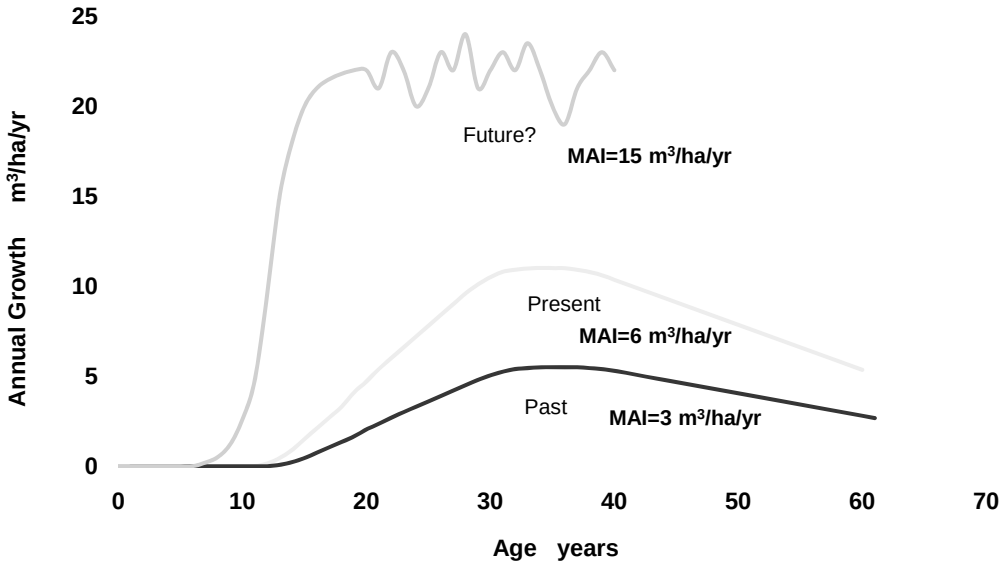
Progressive Forestry for Production Forests

Questions

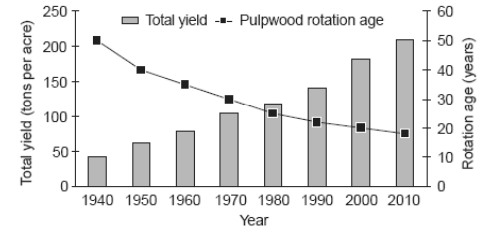
- What are the MAIs of stands that you are currently cutting?
- What will be the MAIs of their replacements?

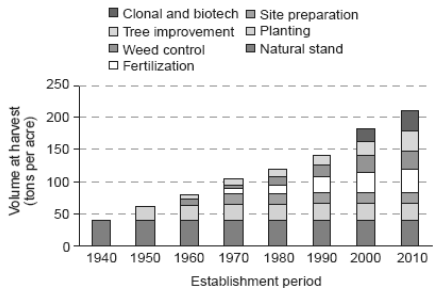
What is Potential Productivity?



What is Possible?

Southern Pine Example - 2 to 20 m³/ha/yr





Fox, Jokela, Allen 2004

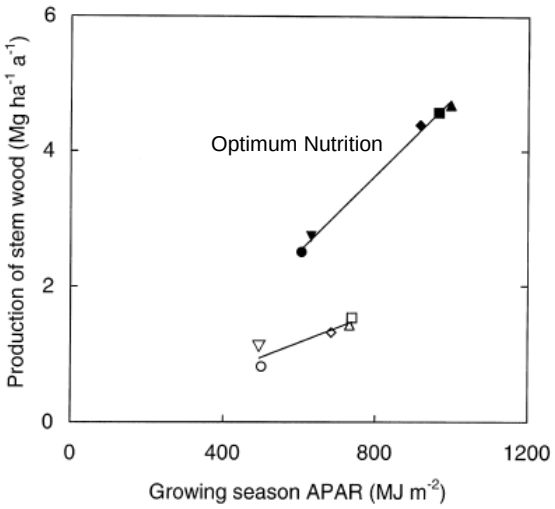
Managing Productivity Requires an Understanding of the Factors Affecting Productivity

Stand Productivity

- Physiological processes
  - Light interception
  - Carbon gain (photosynthesis)
  - Carbon partitioning

Productivity = *f* (Intercepted Light)

Norway Spruce - Flakaliden



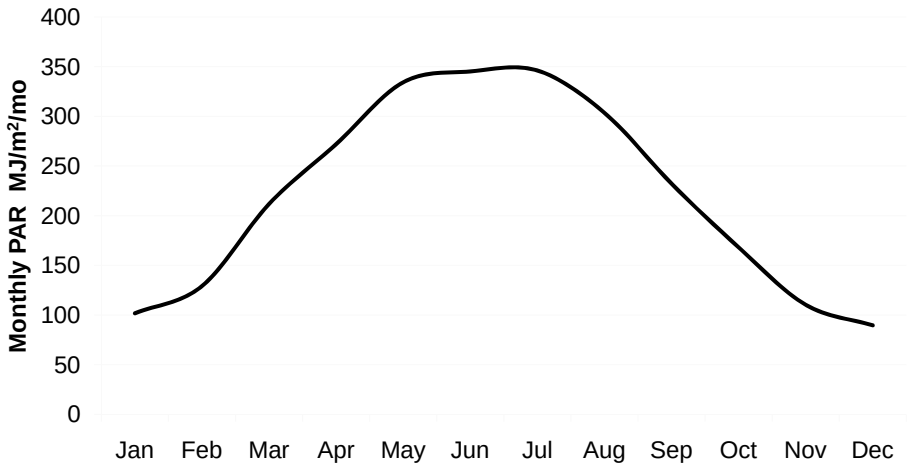
Bergh et al 1999, FEM

INCOMING RADIATION

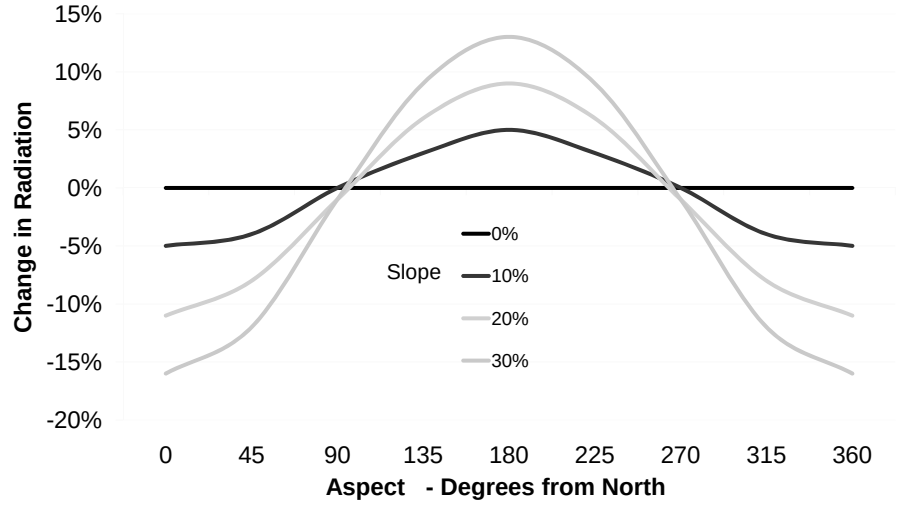
Landsberg and Gower 1997

Estimated Radiation by Month – 47°N

Photosynthetically Active Radiation



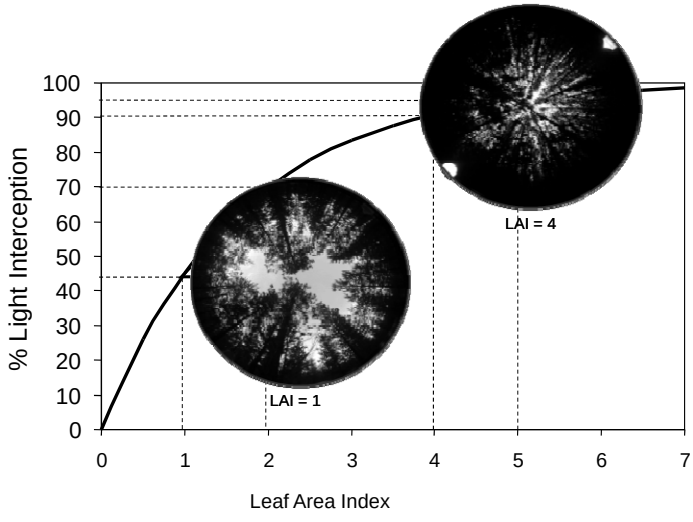
Slope and Aspect Effects on Radiation 47°N



Factors Affecting Light Interception

- Leaf area
- Canopy gap fraction
- Seasonal duration
  - Production
  - Senescence
- Crown Architecture
  - Clumpiness of foliage)
  - Crown shape
  - Angle of foliage display

Light Interception and Leaf Area Index

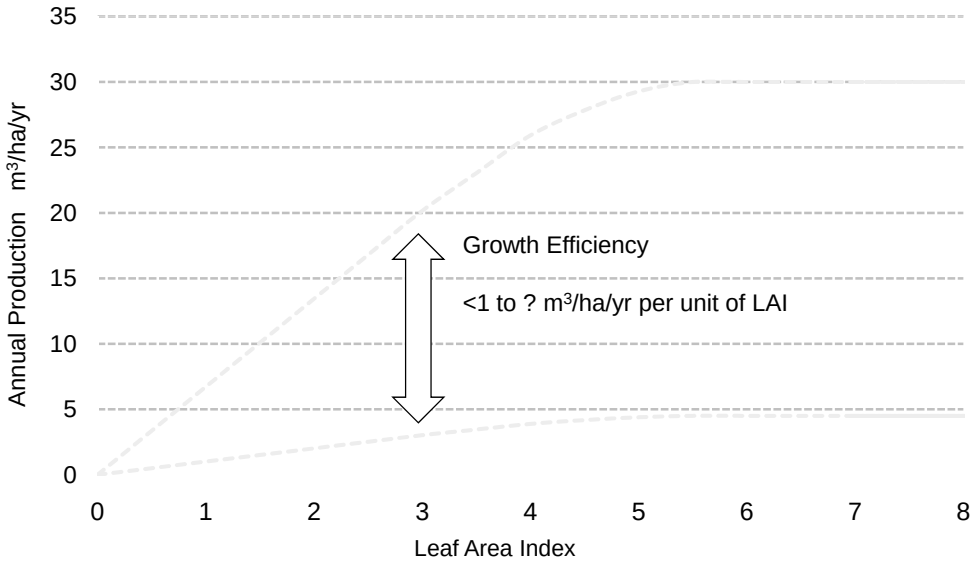


Beer's-Lambert Law

$I = 1 - (e^{(-k * L)})$

k = 0.6

Productivity – Leaf Area Index

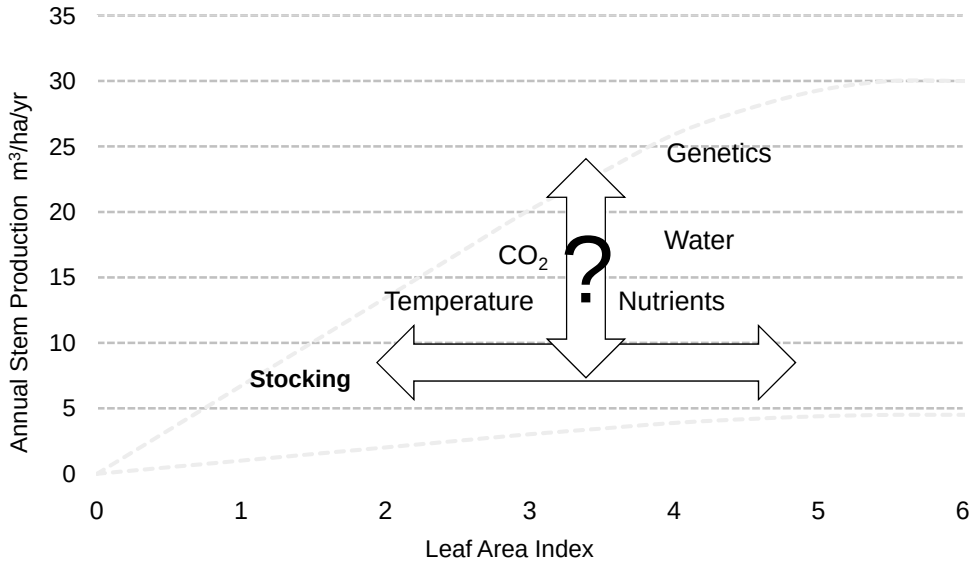


MOST FORESTS
ARE NOT EFFECTIVELY
CAPTURING OR UTILIZING
LIGHT ENERGY TO PRODUCE
STEMWOOD

Factors Affecting Leaf Area and Growth Efficiency

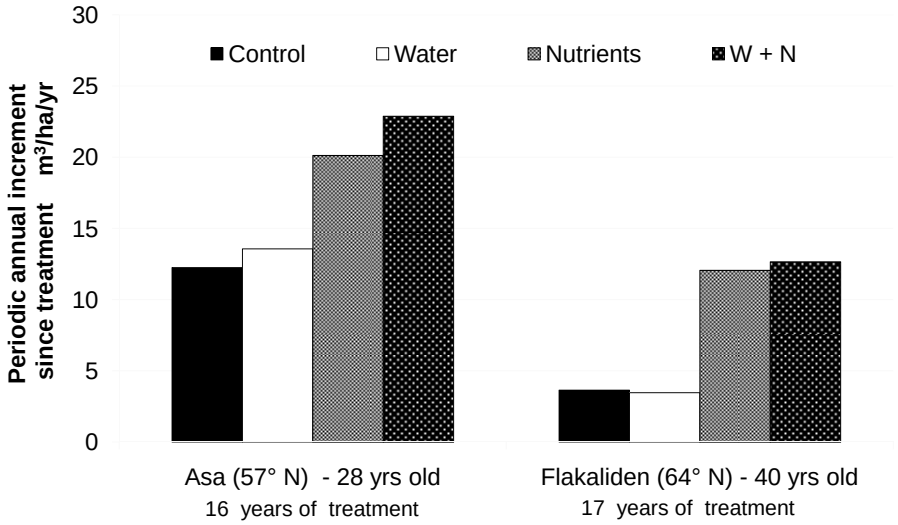
- Genetics
- Stand Density
- Resource Availability
- Age

Factors Affecting Leaf Area & Growth Efficiency



What is POSSIBLE for Spruce?

Norway Spruce – Sweden



Albaugh et al, 2009 FEM

Norway Spruce

Flakaliden Nutrient x Water Study

Control

1992

+Nutrients

Norway Spruce

Flakaliden Nutrient x Water Study

Control

2009

+Nutrients

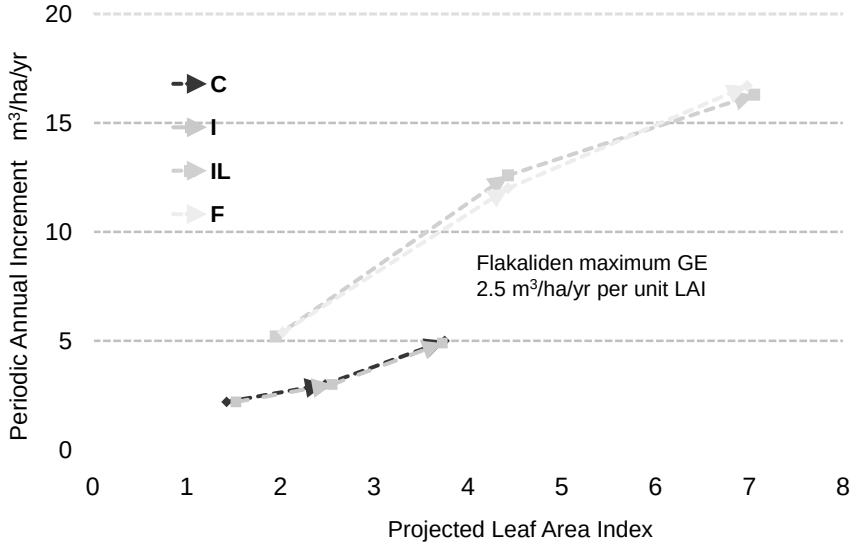
Response to Nutrient and Water Additions

Norway Spruce – Northern Sweden

LAI = 7

Stem Production and Leaf Area Index

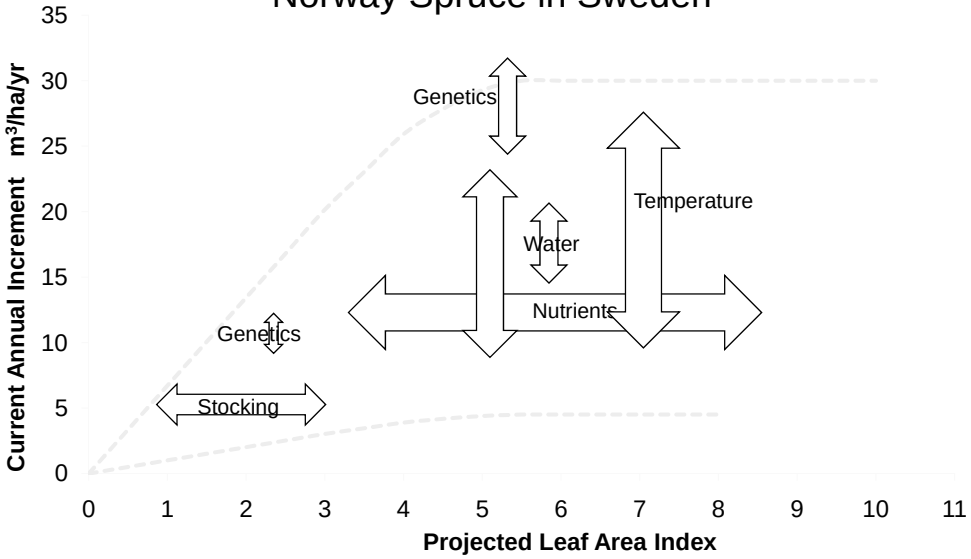
Flakaliden 1987- 2001



Data from Bergh et al 2005, FEM and Sune Linder

Factors Affecting Productivity

Norway Spruce in Sweden



Liberally interpreted from Bergh et al 2005 and others

Questions Remain for the Acadian Forest!

- What are the factors that limit stand leaf area production and retention …on a site and stand development (time) specific basis?
- What are the factors that limit growth efficiency …on a site and stand development specific basis?

- Is it biologically possible to ameliorate any of these limitations?
- Should these limitations be ameliorated?