

Growth Intercept Models of Jack Pine Plantations in Northern Ontario

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Site index

- Even-aged and pure stand
- Site tree: dominant or co-dominant, damage free
- Average top height of site trees at 50 year of breast height age

What is a growth intercept?

- Growth intercept (GI) is defined as average annual height growth above breast height
- Typically height growth is averaged over a 5-year period

What is a growth intercept model?

- It is a model that links site index to average height growth
- It can be used to estimate site index from the average annual height growth
- $SI = 1.3 + b_1 GI^{b_2} + \varepsilon$
- GI is the top height of the site tree

Why growth intercept model?

- We have site indices (SI) to estimate site productivity for natural stands in NW Ontario (Carmean et al. 2001)
- Can we apply these site indices developed for natural stands to plantations?
- Do plantations grow fast than natural stands that we harvested on the same site?

Variable growth intercept

- Growth intercept is good only for trees with obvious annual whorls such as red pine.
- Variable growth intercept model relates the average annual height growth of trees to site index

The advantages of Variable GI model

- Developed specifically for estimating site index, not height
- Intended for young stands or young plantations
- Not constrained to pass through the site index at index age
- Less sensitive to small deviations from the mean height when compared to height-age models

We have done in 2004 and 2005

- We sampled 64 jack pine plantations
- Finished stem analysis on all sampled trees
- Used published jack pine site index data (Carmean and Lethall 1989)
- Developed growth intercept models for jack pine plantations for NW Ontario

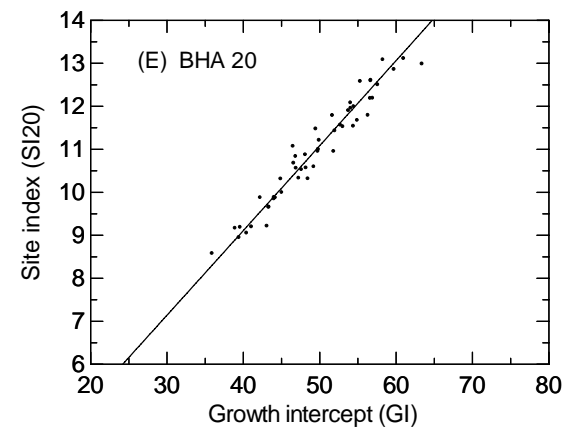
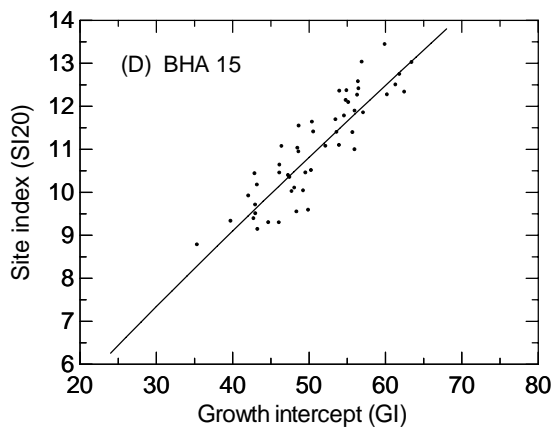
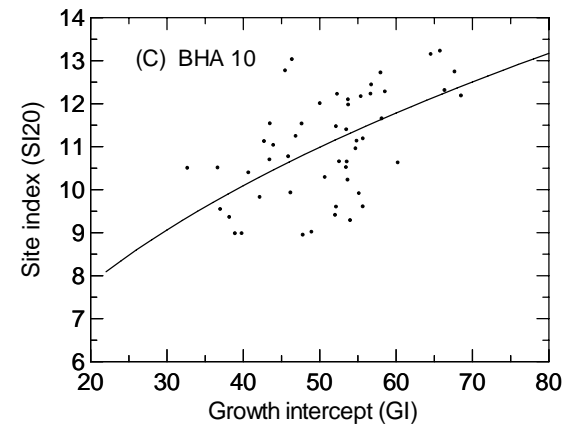
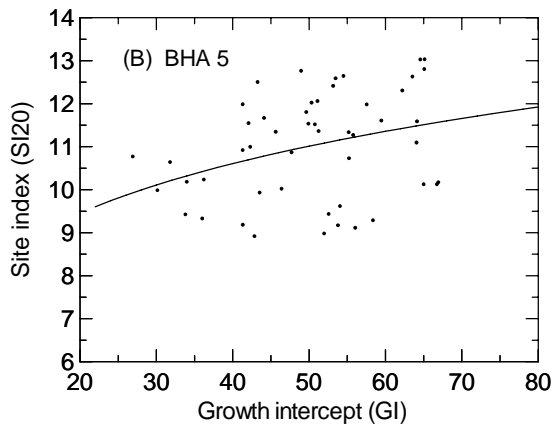
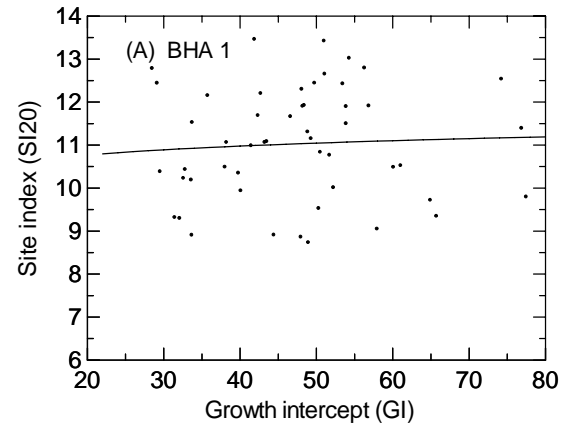
We are planning to do

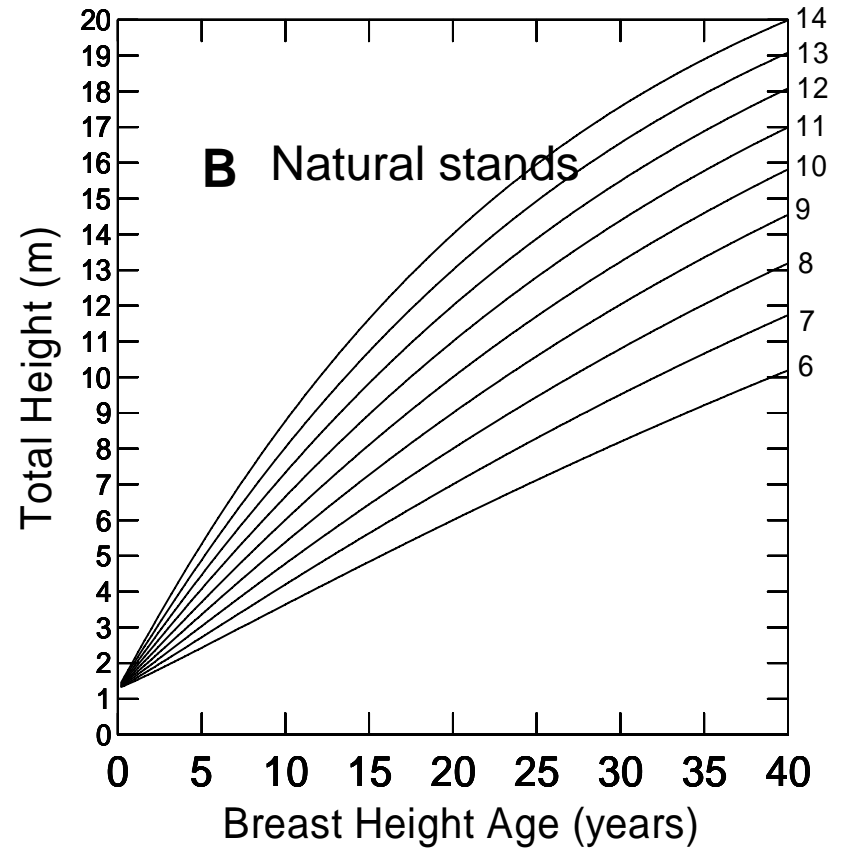
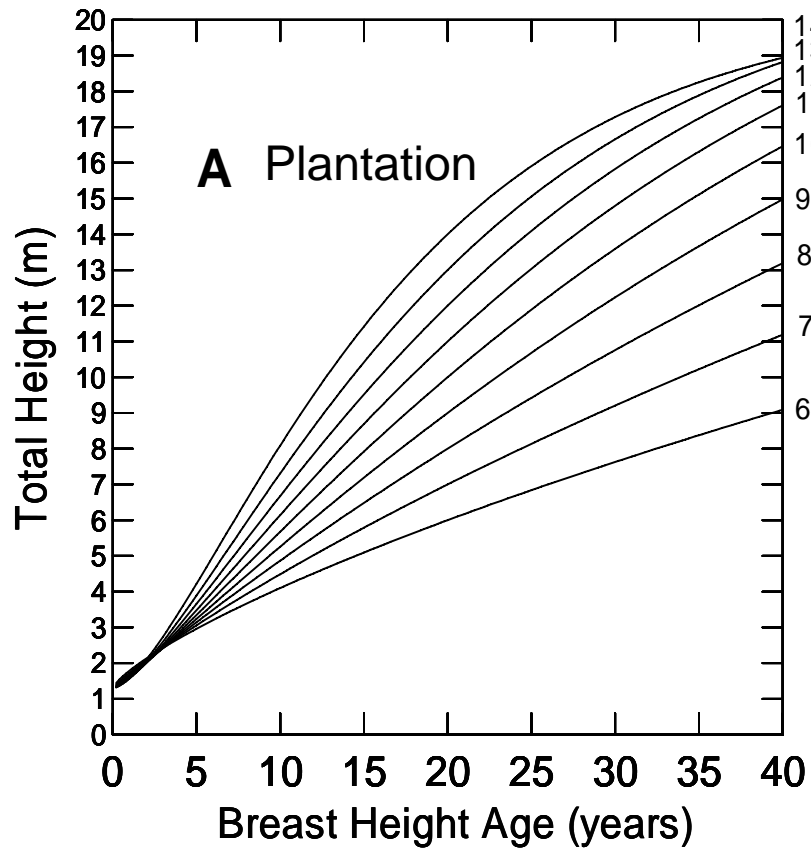
- In 2006 sample black spruce plantations
- Sample more black spruce stands nearby the plantations
- Collect soil samples from each plot
- Finish stem analysis on sample trees
- Basic soil physical and chemical analysis
- Collect silvicultural records of black spruce plantations (as much as possible)

Question to answer

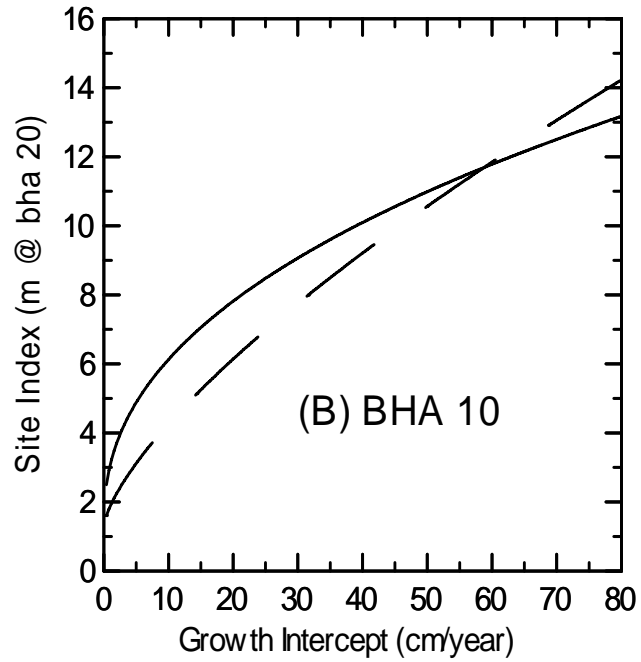
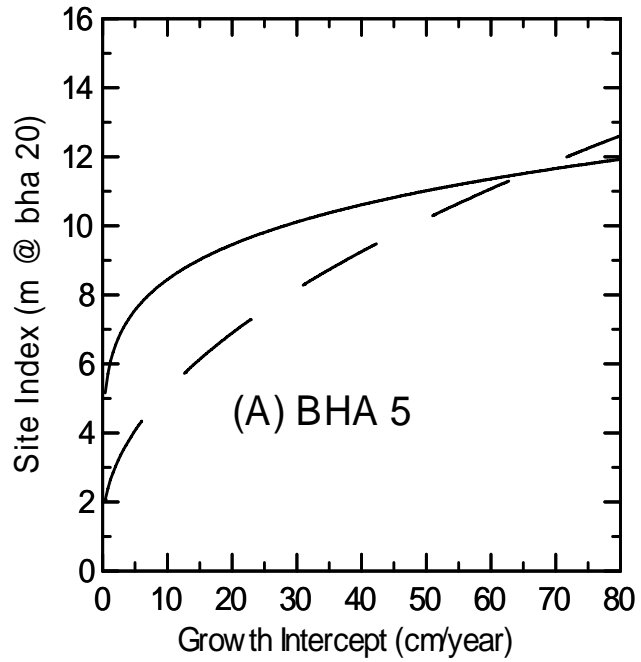
- Growth and yield are affected by changes in climate, silviculture and genetics
- Can we improve site productivity through silviculture (site preparation, vegetation management, ...)?
- Develop growth intercept models linking silviculture practice and soil characteristics

$$SI = 1.3 + b_1 GI^{b_2} + \varepsilon$$



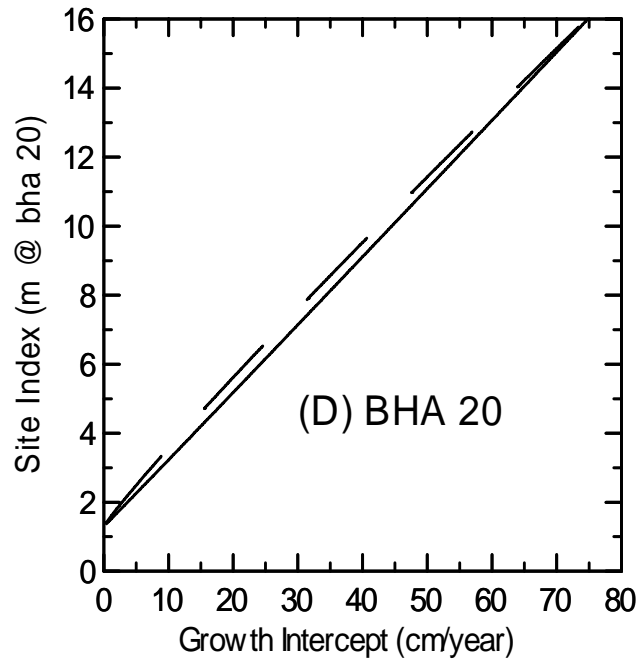
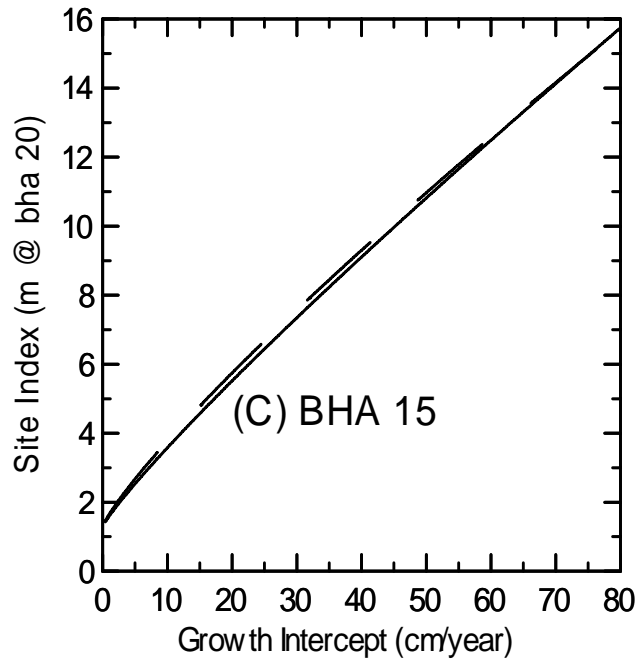


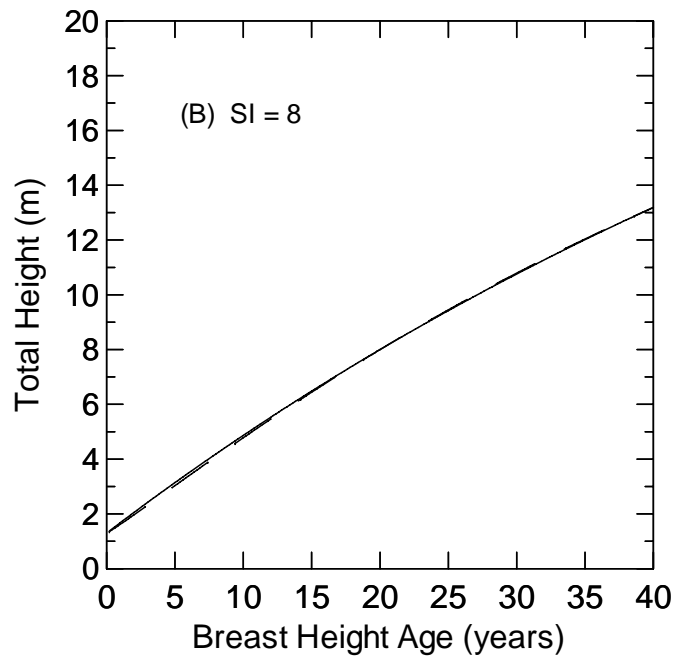
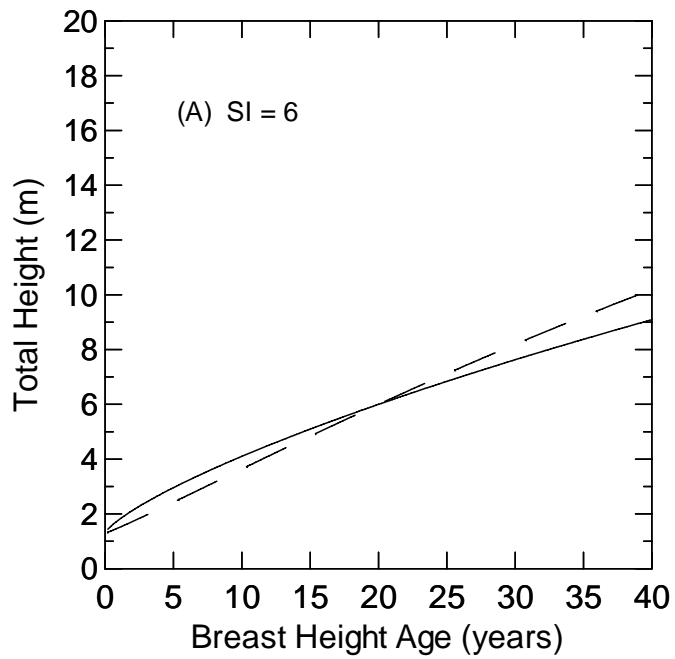
$$SI = b_0 + b_1(HT - 1.3) + b_2 \ln(HT - 1.3) + b_3 \ln(BHA) + b_4 \ln(BHA)^2 + b_5 \ln(HT/BHA)$$



Dashed line:
Natural stands

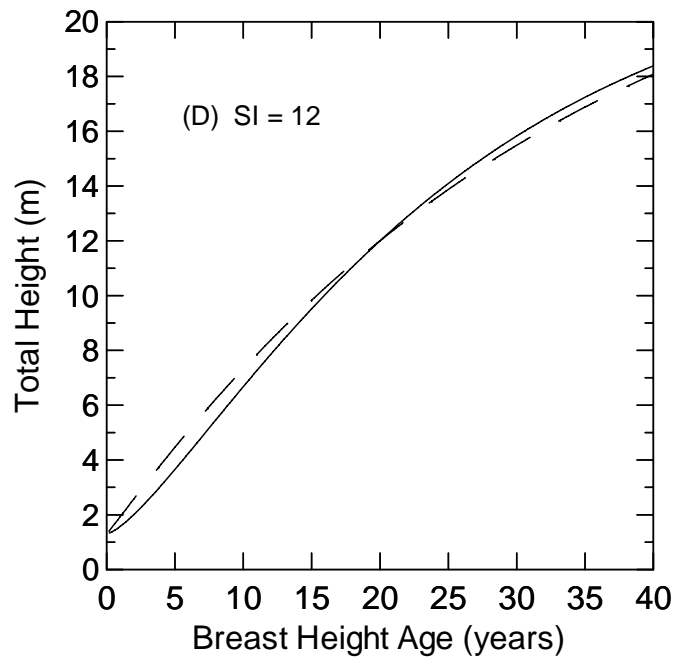
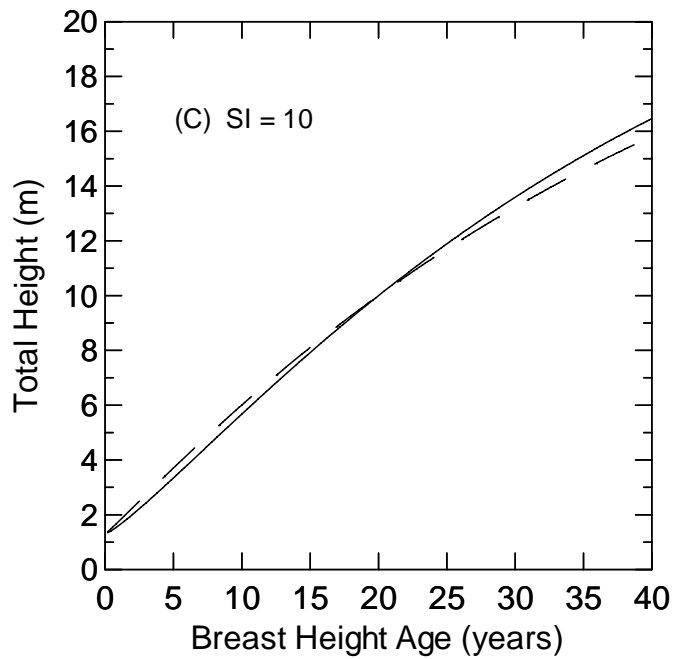
Solid line:
Plantations



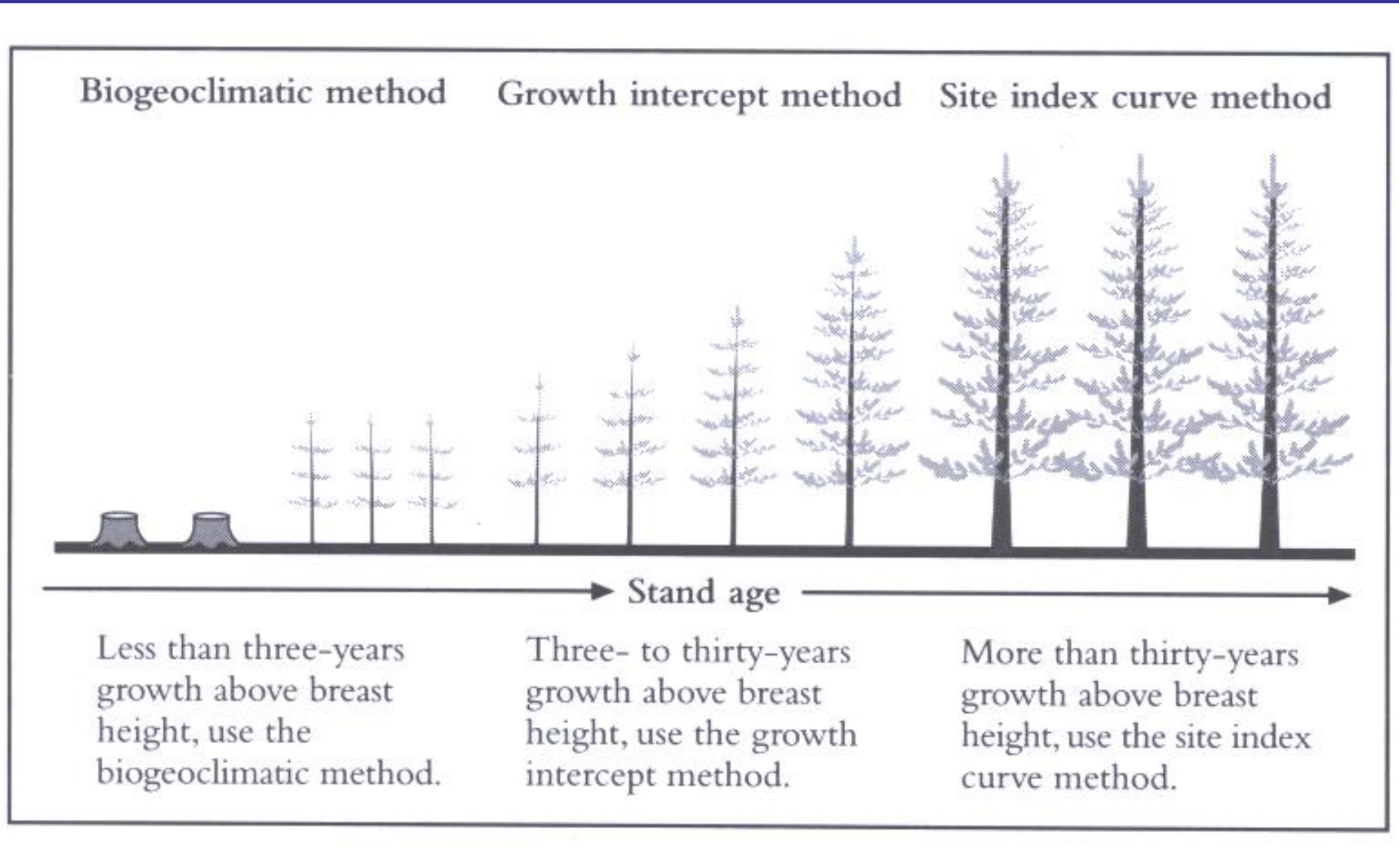


Dashed line:
Natural stands

Solid line:
Plantations



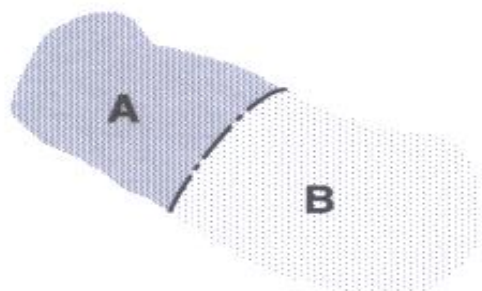
When to use the GI method?



How to use GI?

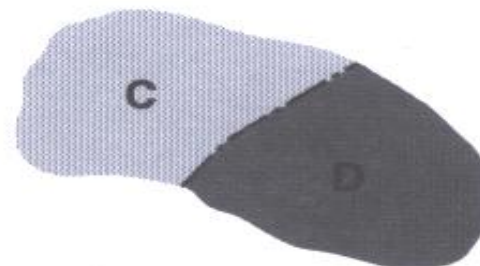
- Pre-stratify the opening (survey site)
- Assess the suitability of each stratum for GI data collection
- Select site index species
- Collect GI data
 - Sample lines
 - Sample trees
 - Sampling intensity: collect GI data on one plot per ha (1-2 sample trees/plot) to a maximum 10 plots per stratum

Stratum must have more than 500 total trees of the site index species per hectare uniformly covering the entire stratum area.



Stratum B is unsuitable for the growth intercept method due to inadequate density of sample trees. Stratum A is suitable.

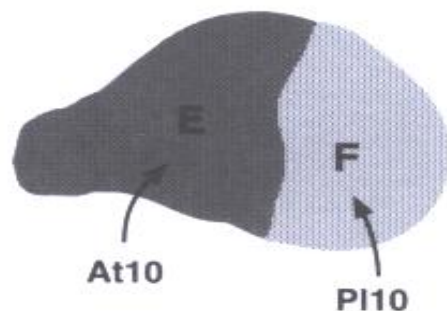
Sample trees must have 3- to 30-years growth above breast height.



Stratum	Inventory Label
C	PI8Sx2-4-0.4-5718/0+(91)(7,0)
D	PI8Sx2-12-3.5-3940/0+(91)(7,0)

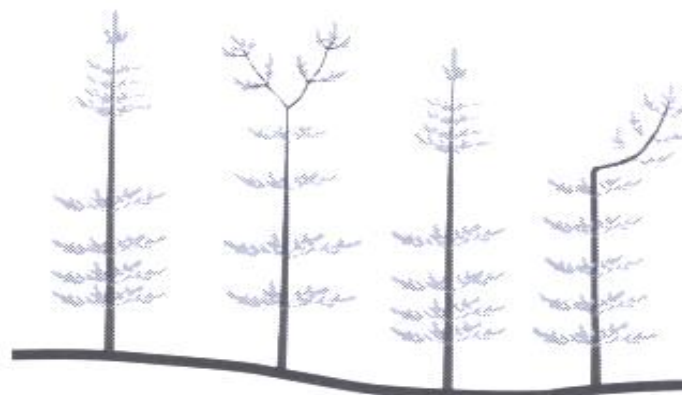
Stratum C is unsuitable for the growth intercept method due to inadequate years of growth above breast height on sample trees. Stratum D is suitable.

To use the growth intercept method, the growth intercept tables must be available for the site index species.

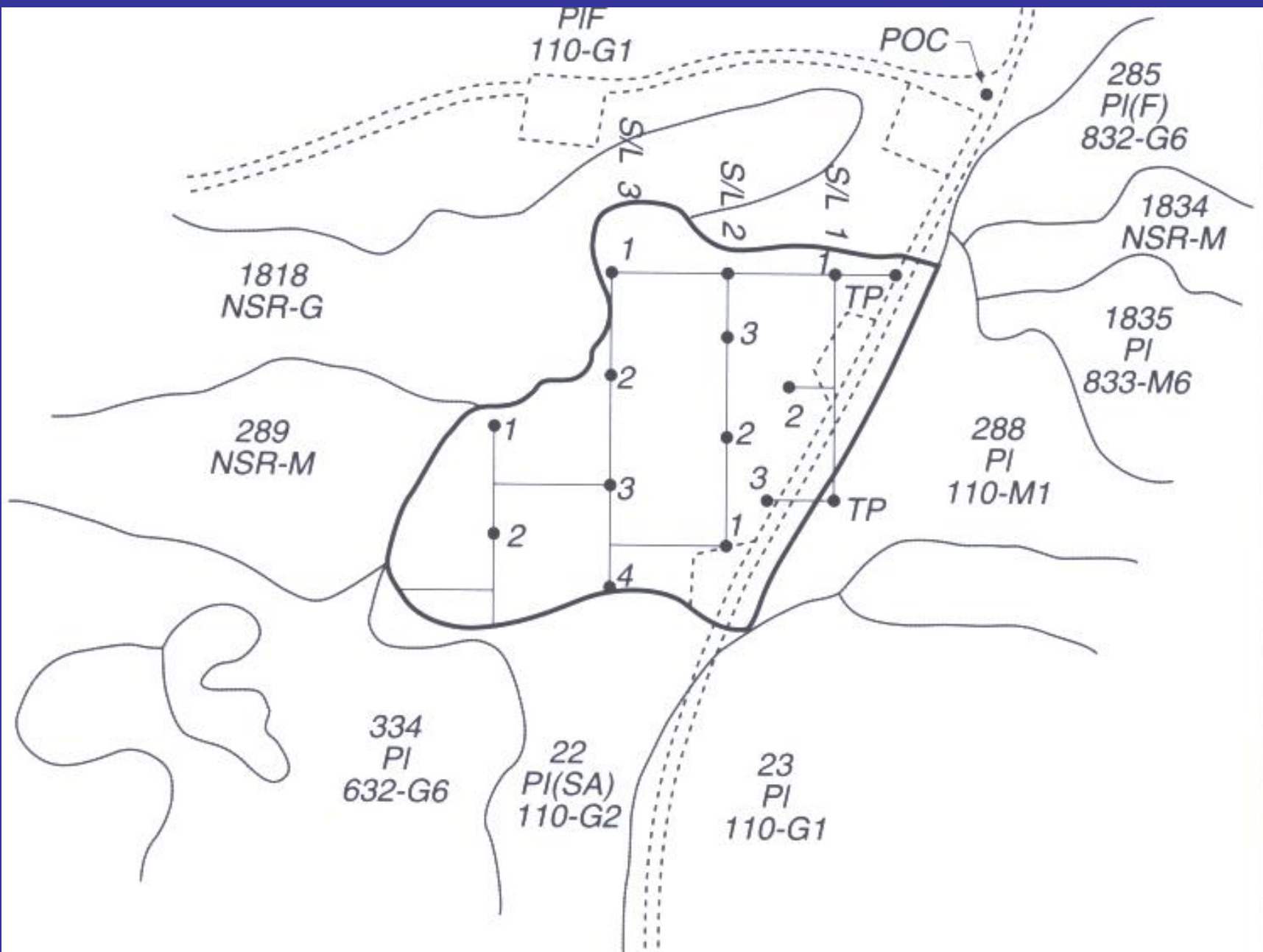


Stratum E is unsuitable for the growth intercept method since growth intercept tables have not been developed for the site index species (At). Stratum F is suitable.

Sample tree height growth must reflect long-term site productivity and not the temporary effects of damage, treatment, or growth suppression.



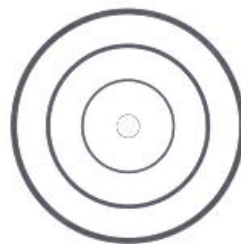
The stratum is unsuitable for the growth intercept method since irregular height growth is common on sample trees.



Sample tree must have vigorous, uniform ring widths from pith to bark at breast height.

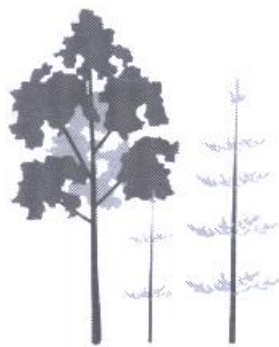


Poor sample tree



Good sample tree

Sample tree must be a dominant or co-dominant tree, not overtopped by trees or brush, with largest DBH of the site index species.



Poor sample tree



Good sample tree

Sample tree must have an undamaged stem with vigorous, uniform annual height growth above breast height.



Poor sample tree

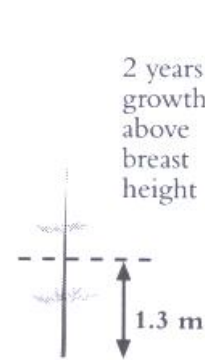


Poor sample tree



Good sample tree

Sample tree must have 3- to 30-years growth above breast height.

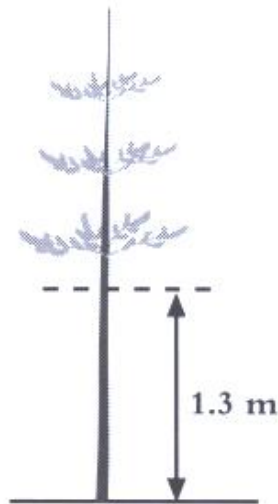


Poor sample tree

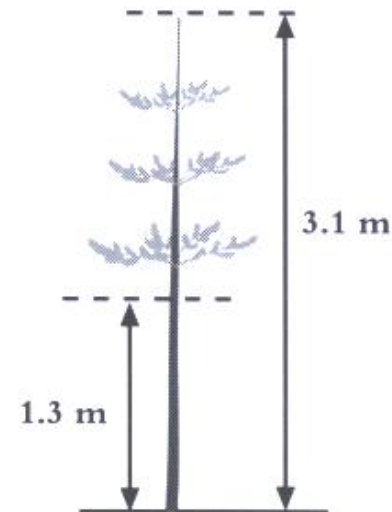


Good sample tree

Step 1: Locate breast height

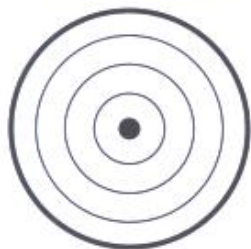


Step 2: Measure total height



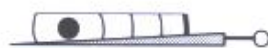
Step 3: Determine breast height age by one of two methods

1. fell tree and count rings



4 years old

2. count rings on increment core



4 years old

Step 4: Record species, height, and age on field card

Plot no.	Species	Total height (m)	Breast height age (yr)
1	Pl	3.1	4

How to use GI?

- Look up the GI-SI table and find the SI for the sample tree
- Compute the average site index for each stratum
- Use the SI in your growth and yield prediction and forest management planning

Use the new SI curves

- Carmean, W.H., Niznowski, G.P. and Hazenberg, G. 2001. Polymorphic site index curves for jack pine in Northern Ontario. *Forestry Chronicle* 77:141-150.
- Carmean, W.H., Hazenberg, G. and Deschamps, K.C. 2006. Polymorphic site index curves for black spruce and trembling aspen in Northwestern Ontario. *Forestry Chronicle* 82:231-242