Data to Initiate GY Models

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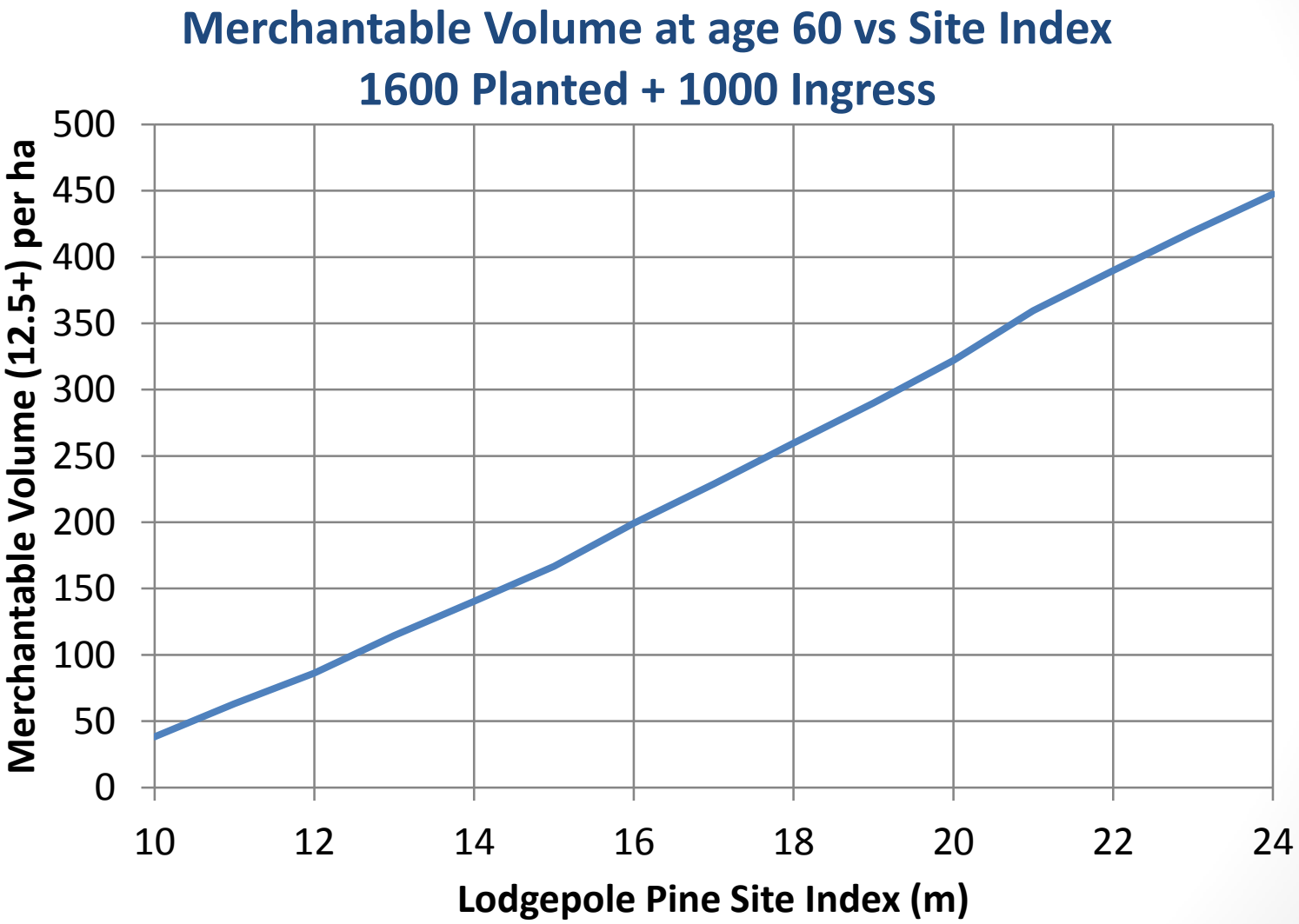
Data, data, data…

- Growth and yield folks always seem to be talking about data needs.
- This is because data is needed for three general purposes
    1. To build models
    2. To check models
    3. To initiate models
- Today's talk is going to focus on #3 – data required to initiate models.
- In particular data required to initiate models to generate yield curves for regenerated stands and how these needs are changing.

What Factors Influence Future Yields?

- Site productivity
- Species composition
- Genetic worth
- Spatial distribution
- Temporal distribution
- Density
- Forest health

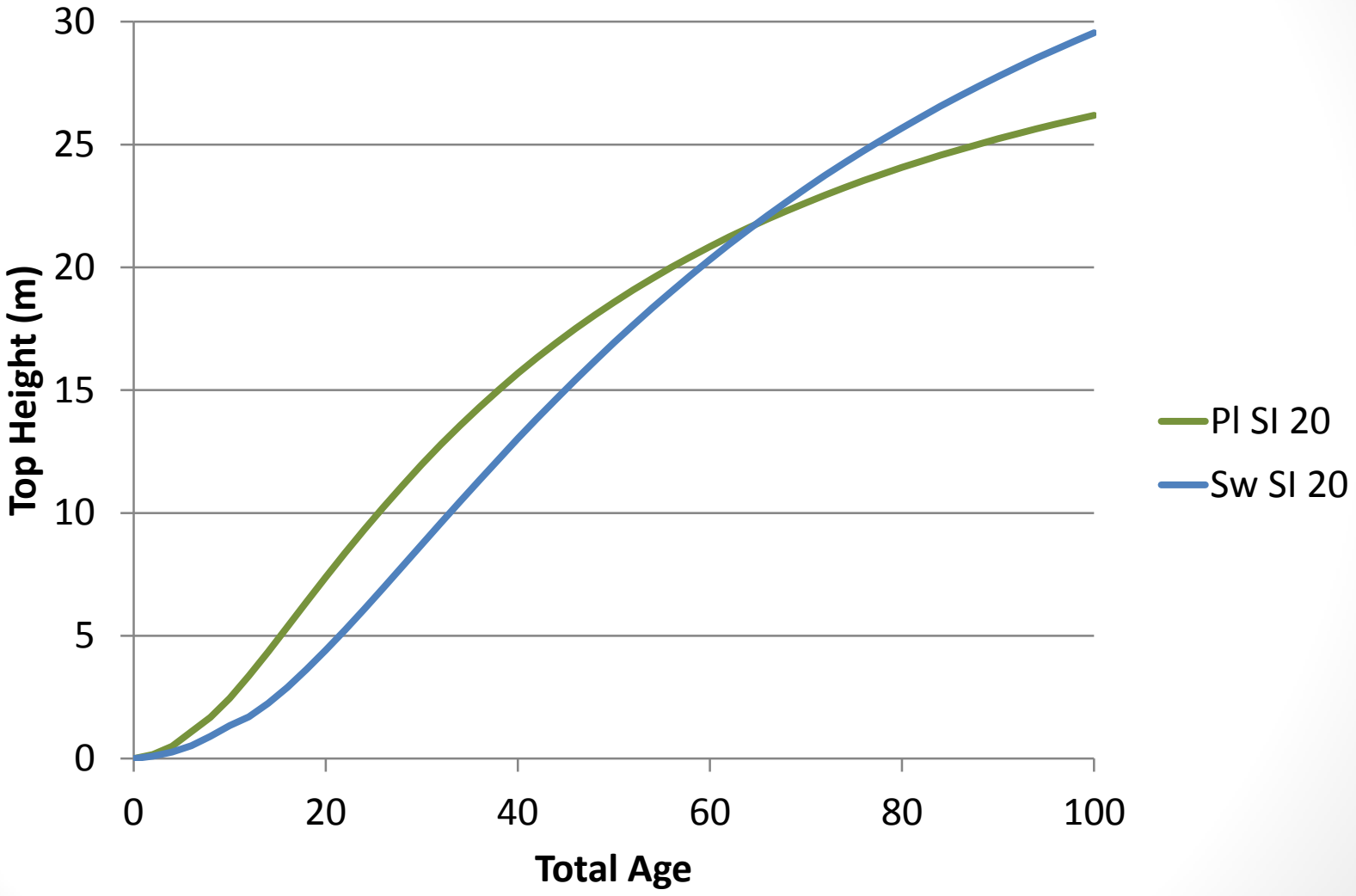
Site Index


Merchantable Volume at age 60 vs Site Index
1600 Planted + 1000 Ingress
Merchantable Volume (12.5+) per ha
500
450
400
350
300
250
200
150
100
50
0
10
12
14
16
18
20
22
24
Lodgepole Pine Site Index (m)

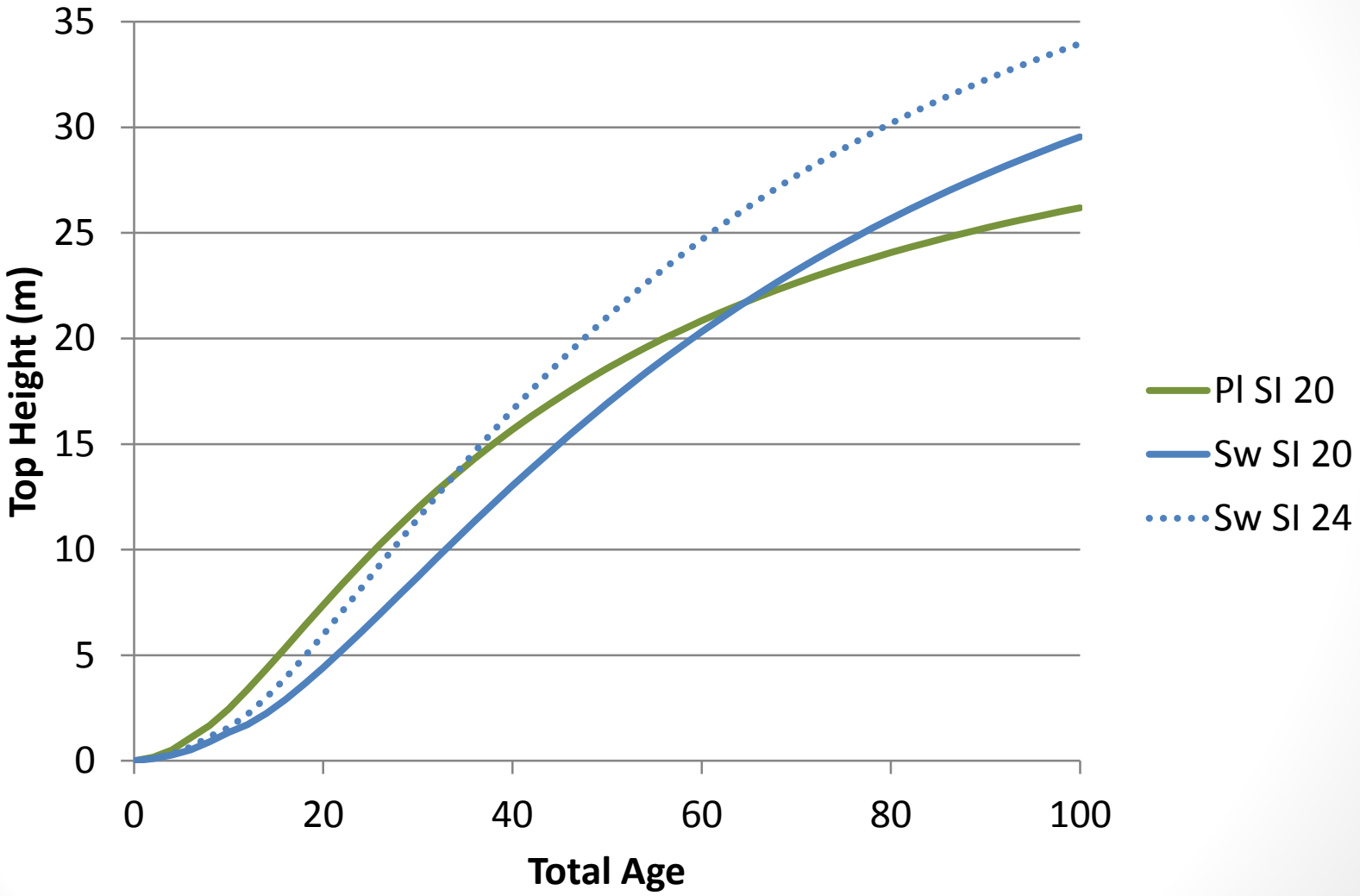
Species Composition

- Mixed species stands have much more variation between individuals than single species stands which in turn leads to more types of competitive interactions.
- The proportions of different species and their spatial arrangement will influence how the stand develops.
- Different height growth patterns and levels of shade tolerance also play significant roles.

Site Index & Stratification in Mixtures



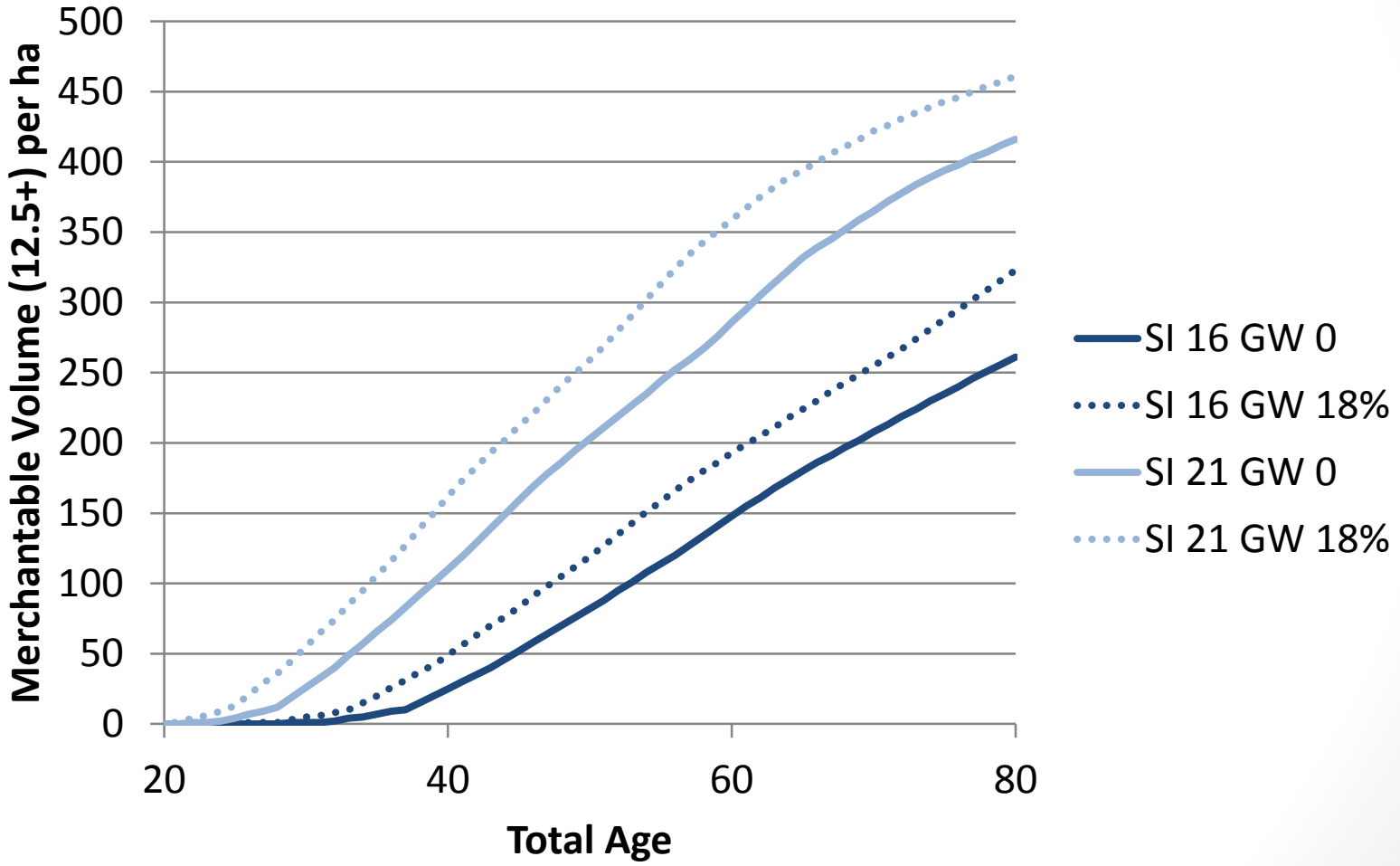
Site Index and Stratification in Mixtures



Genetic Gain

- Projected volume increases resulting from increased genetic worth can be significant.
- As genetic gain is modelled as a percentage increase it results in higher absolute volume gains on higher sites.

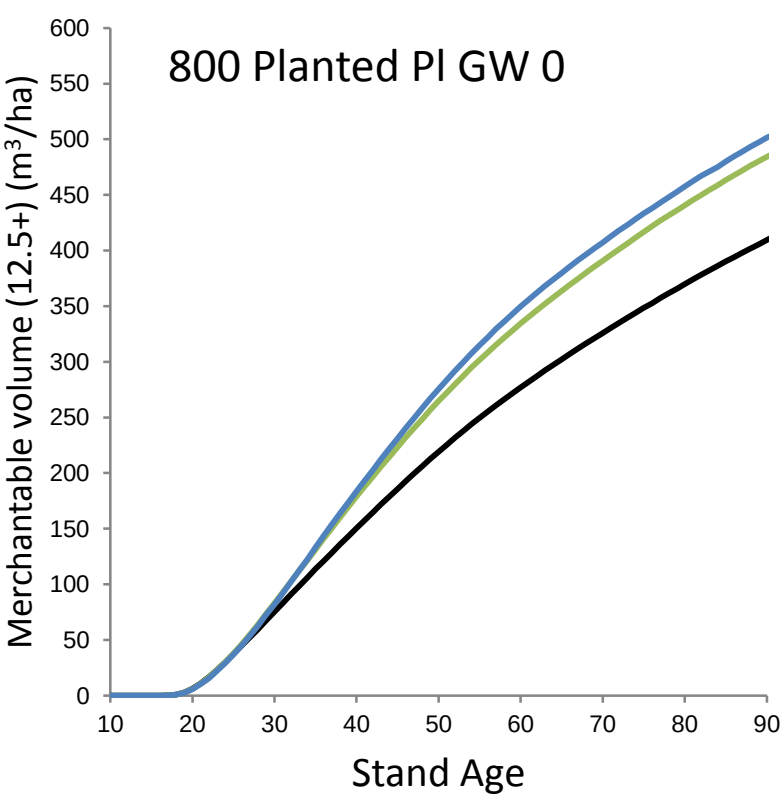
Sw Genetic Gain 18% SI 16 & 21

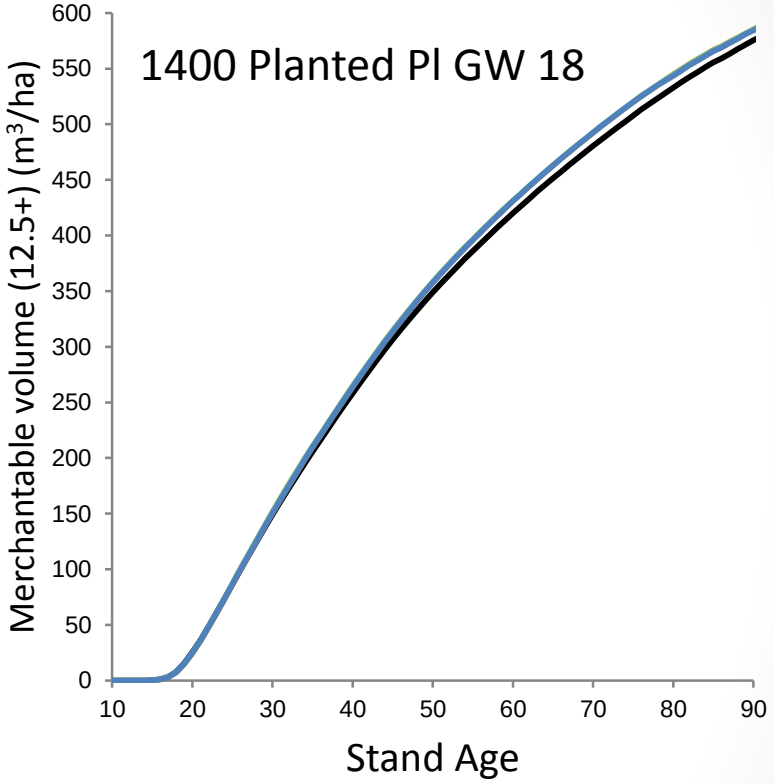


Spatial Distribution

- The key factor is the size and distribution of unoccupied areas (holes) in the stand.
- Knowing whether a stand was planted is critical as we assume the planting will cover the site and leave few to no holes.
- In terms of merchantable volume production, the importance of knowing the amount, temporal and spatial distribution of the ingress decreases as the planting density and genetic worth of the planting stock increase.

Spatial Distribution



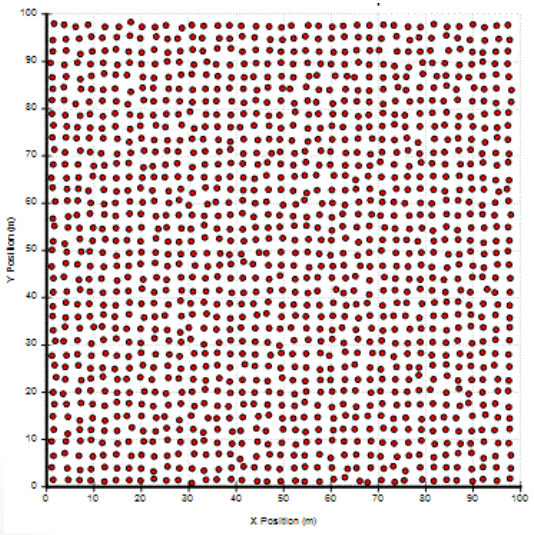


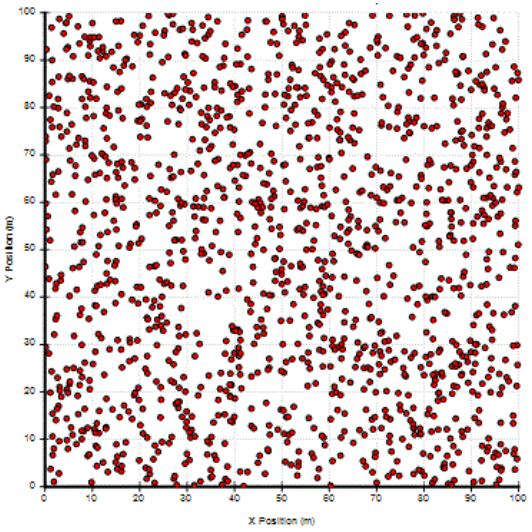
0 Ingress 1000 Ingress 2000 Ingress

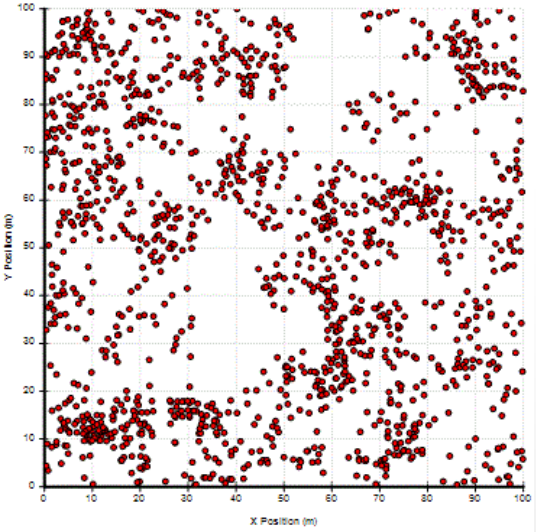
Spatial Distribution

- TIPSY is limited to 3 spatial distributions

Planted	Random	Clumped

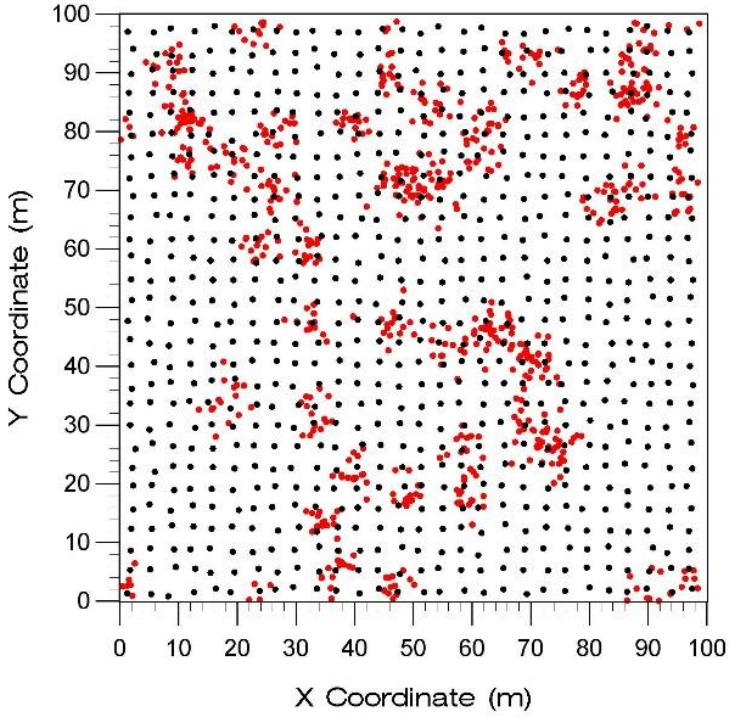




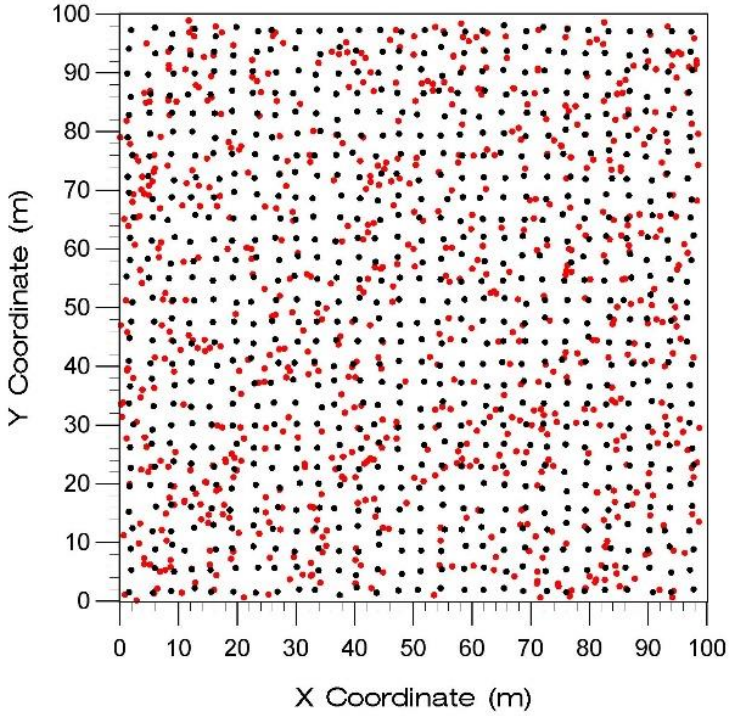


Spatial Distribution

- TASS has UNLIMITED spatial distributions

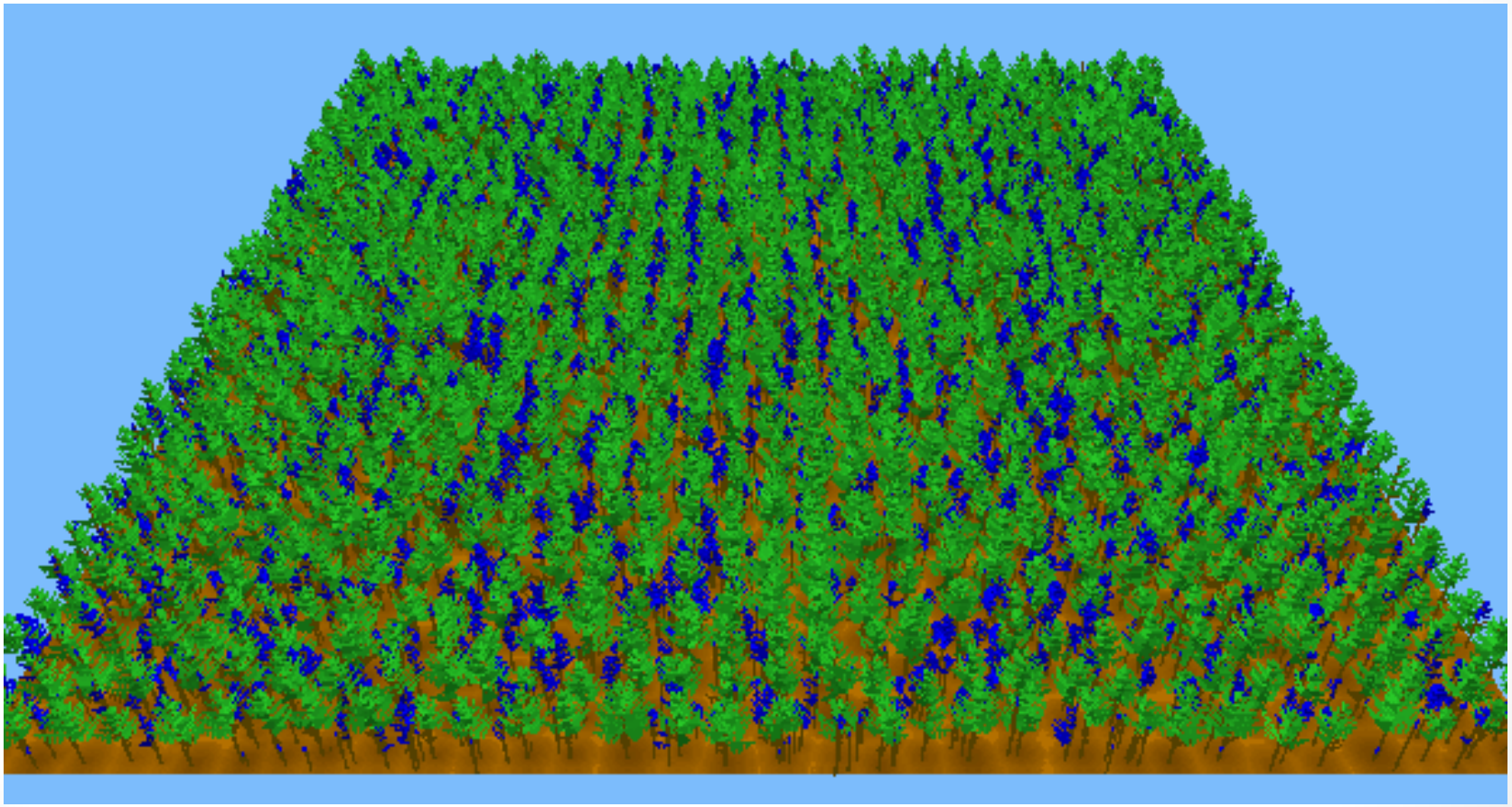


Planted with strongly clumped ingress

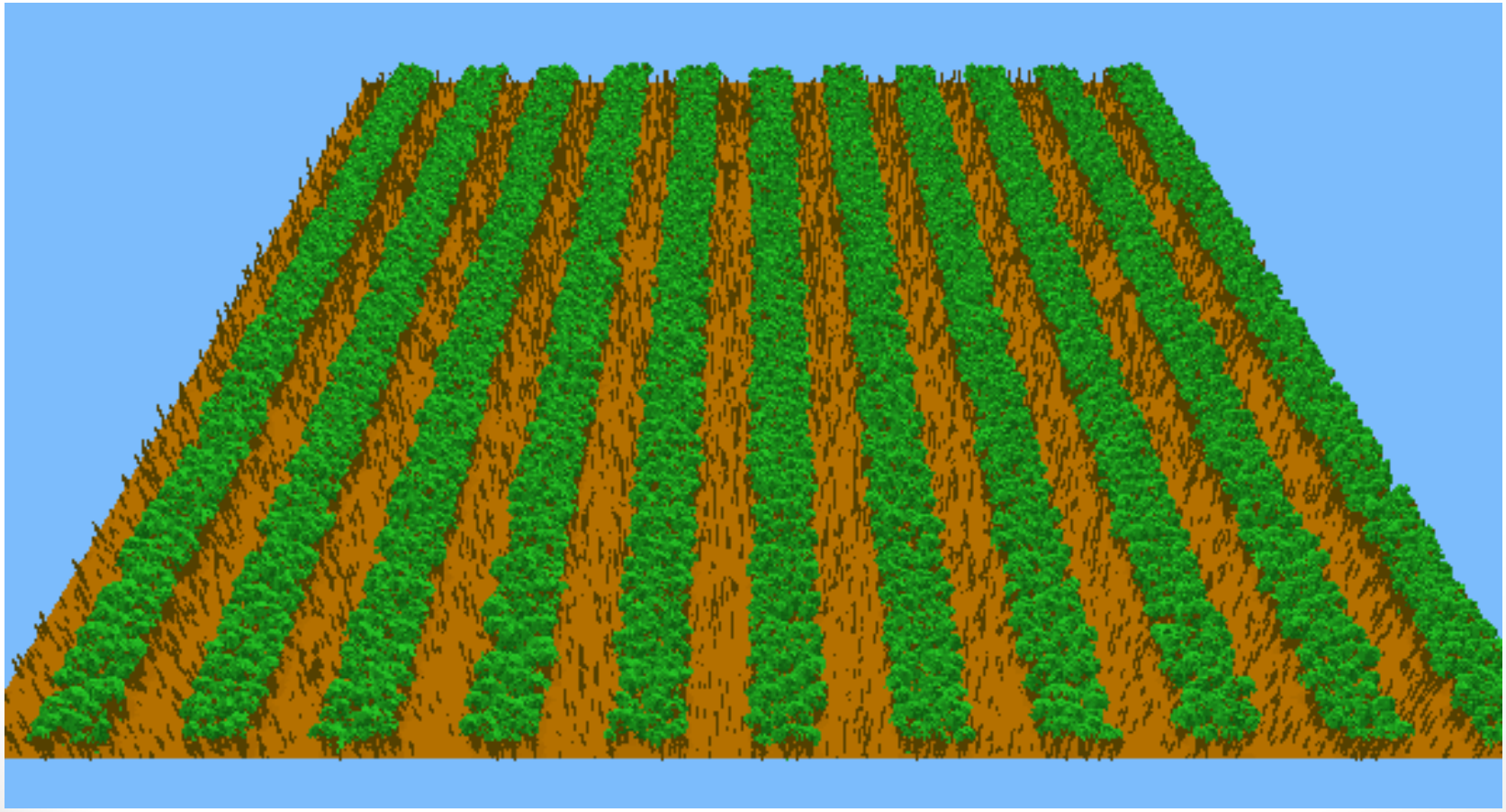


Planted with random ingress

Spatial Distribution - TASS



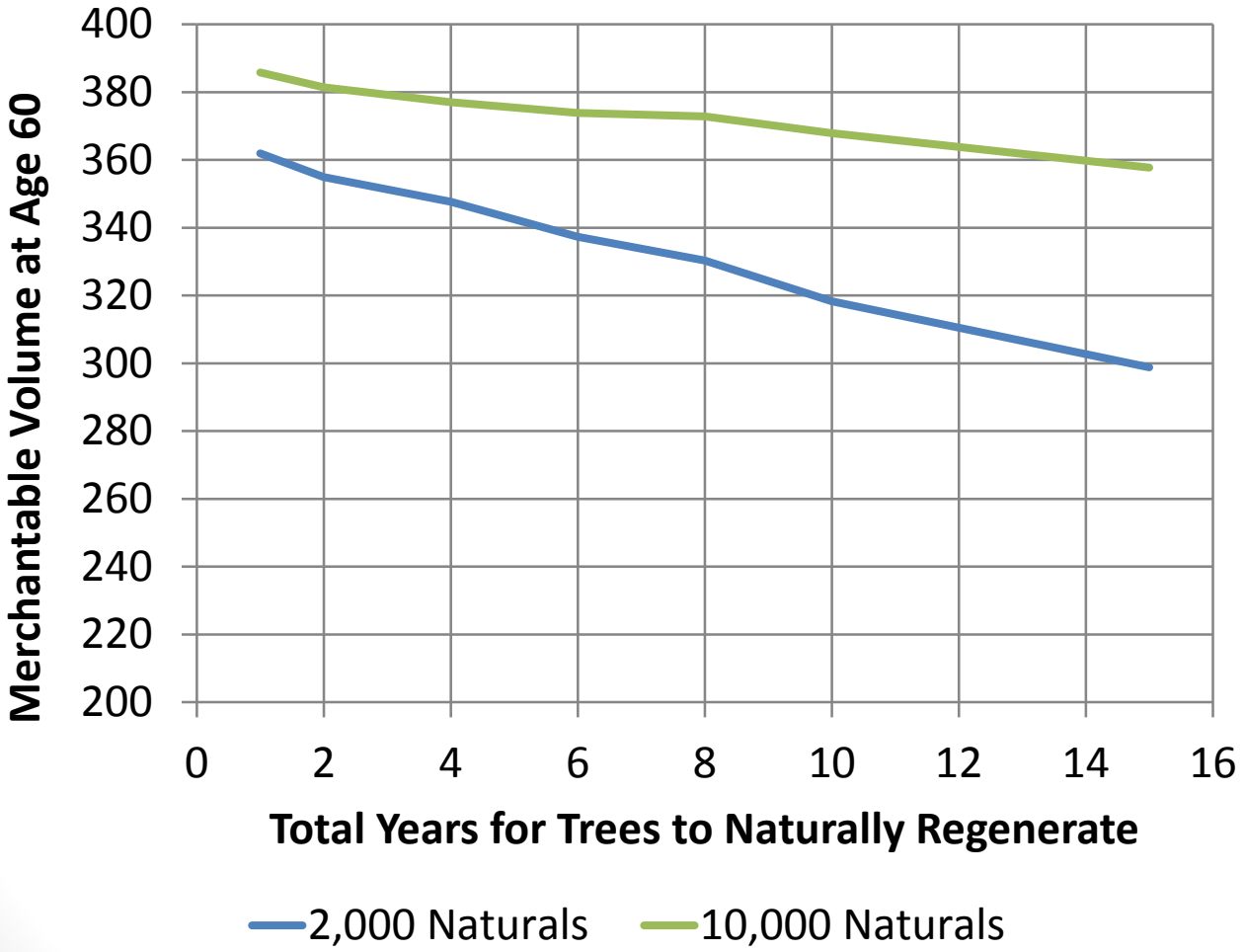
Spatial Distribution - TASS



Temporal Distribution

- The assumed temporal distribution of the ingress can have a significant impact **if** the planting density is below current operational densities.
- TIPSY has default temporal distributions for natural ingress.
- In TASS you can specify any temporal distribution you want for the natural ingress.
- Temporal distribution can be important, but is generally not as important as the spatial distribution (the holes!)

Temporal Distribution



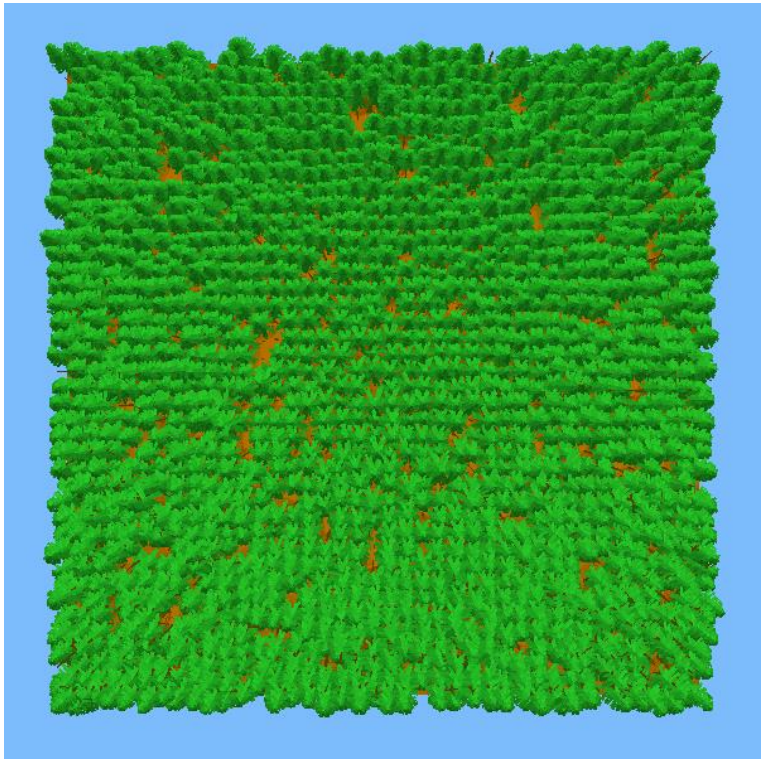
Assuming an equal number of trees regenerate each year.

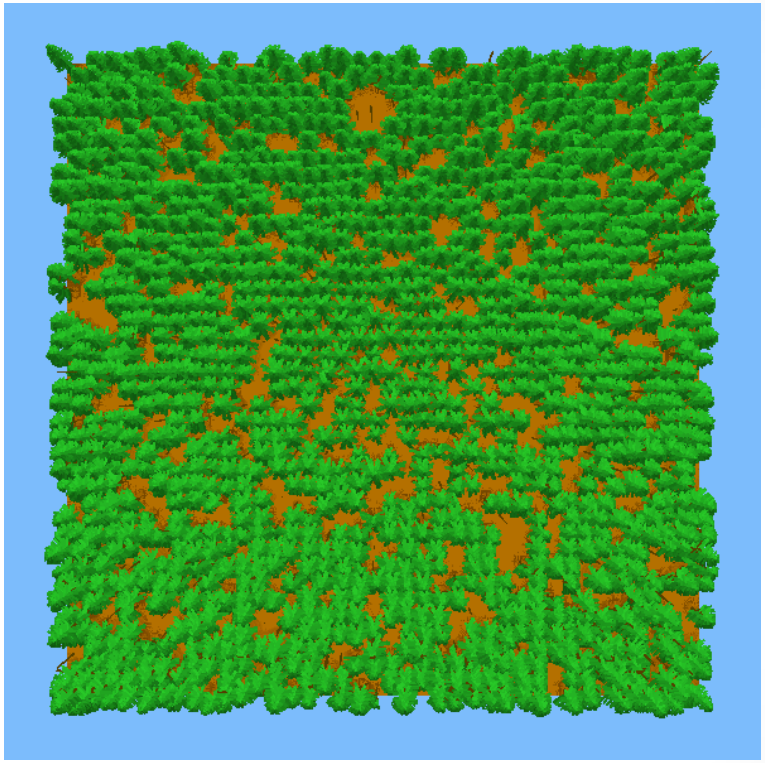
E.g., if the density is 2,000 and the temporal distribution is 4 years, then 500 trees regenerate in each of the 4 years.

Forest Health

- Forest health can have a significant impact on the growth and development of stands.
- The impact on future yield is a function of the timing (stage of stand development), number and sizes of trees infected and killed.

Forest Health





So what is take home message?

- Knowing what (if any) trees were planted is very important to obtaining a reliable projection of the stand.
  - This tells us that there were likely few holes in the stand at the time it was planted.
  - We know the genetic worth to apply.
  - We know the species.
  - We know the trees per ha planted.
- Site productivity (site index) estimates are critical.
- Species composition is important
  - Relative growth rates between species is important
- Ingress species, numbers, spatial and temporal patterns are important for projecting size distributions (value implications) and forest health impacts.

So what is take home message?

- If we want to project existing stands, then we need data on the numbers, species, health (agents, severity, tree sizes) and sizes (heights and diameters) of trees in the stand.
  - In this case the planting information is used to obtain genetic worth, and upper limits of the number of trees by species to apply the genetic worth to.
- TASS will have an existing stand start up routine.

Currently Available Data

- Information on regenerated stands comes primarily from silviculture surveys and planting records.
- This information is captured initially in RESULTS and then a portion of it is transferred to the VRI.

- Can we get all the information we need from RESULTS?
- Unfortunately no.

Silviculture Surveys

- The current generation of silviculture surveys were not designed to provide inputs to growth models.
- They were designed to collect information to assess regulatory benchmarks.
- Well-spaced trees have little to no use for GY purposes.
- The emphasis on counts (total or well-spaced trees) severely limits the utility of silviculture surveys for initiating more sophisticated GY models or contributing to GY analysis in general.

The “label” debate

- Sometimes the debate is over which label to use for model inputs
  - Inventory label
  - Silviculture label
- Both are based largely on counts.
  - Silviculture label – counts of well-spaced free-growing trees
  - Inventory label – counts of all trees.
- Using TIPSY compounds the problem because TIPSY does not model mixed species stands.
- If we are moving to TASS, then need to move past the label debate – NEITHER is what we need.

The “label” debate

- Once trees start to differentiate in size, measurements of height and diameter become infinitely more valuable than simple counts, no matter how you categorize those counts.
- So the label debate becomes a moot point as we move forward towards collecting better information.

Planting Information

- In general, only available at the opening level – not at the inventory polygon level.
- If multiple species are planted in an opening we don't know how they were distributed
  - Smaller patches of pure planting?
  - 1:1 mixtures of species A and B, plus pure patches of C?
  - 2:1 mixtures of species A and C, plus pure patches of B?
- How the species are mixed can have significant impacts on growth projections.
- Knowing how the species are mixed (or not) will affect projections of forest health impacts.

What can we do?

- Overall – consider revisions to the silviculture surveys and the regenerated stand inventory.
- This will require input from a wide range of disciplines
  - Silviculture
  - Inventory
  - Growth and yield
  - Sampling
  - Forest health
  - Legislation / Policy
  - Remote sensing
  - Database design
  - GIS
  - ??

Planting Information

- For areas where the prescription is to plant, could we replace the regeneration survey with a requirement to submit spatial planting records?
- Create a “planting” layer for the inventory?

Free-Growing Declaration

- One option is to reduce the survey requirements for free-growing.
- Switch to more professional sign-offs and audits.
- Take the money saved and use it for a later inventory survey.

Landscape Level Regeneration Standards

- If landscape-level standards are developed, then by definition, information is needed to project individual stands and assess the collective achievement of future volume targets.
- It is possible that the information collected to project stands to assess a landscape-level stocking standard is the same information used to generate yield curves for timber supply.

Lots of questions…

Lots to discuss…