Status of the National Biomass Estimator Library (NBEL)

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Timber Measurements Society

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Introduction

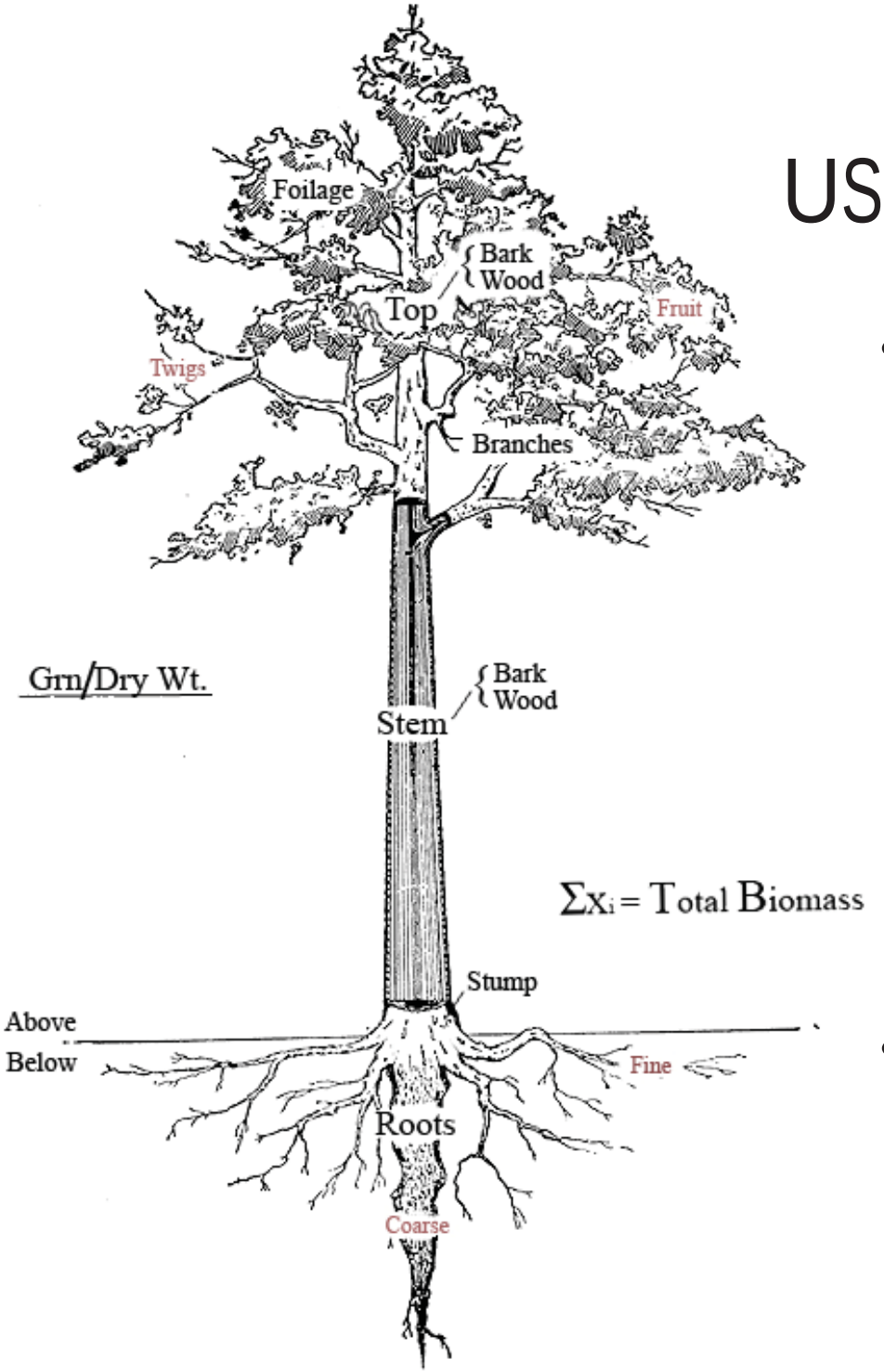
NBEL

- Past, Present, Future
- Measurement and Sampling
- Demonstrations
- Questions

What is biomass?

- Simple definition:
  - **bio**logical **mass** or amount (weight units) of living tissue

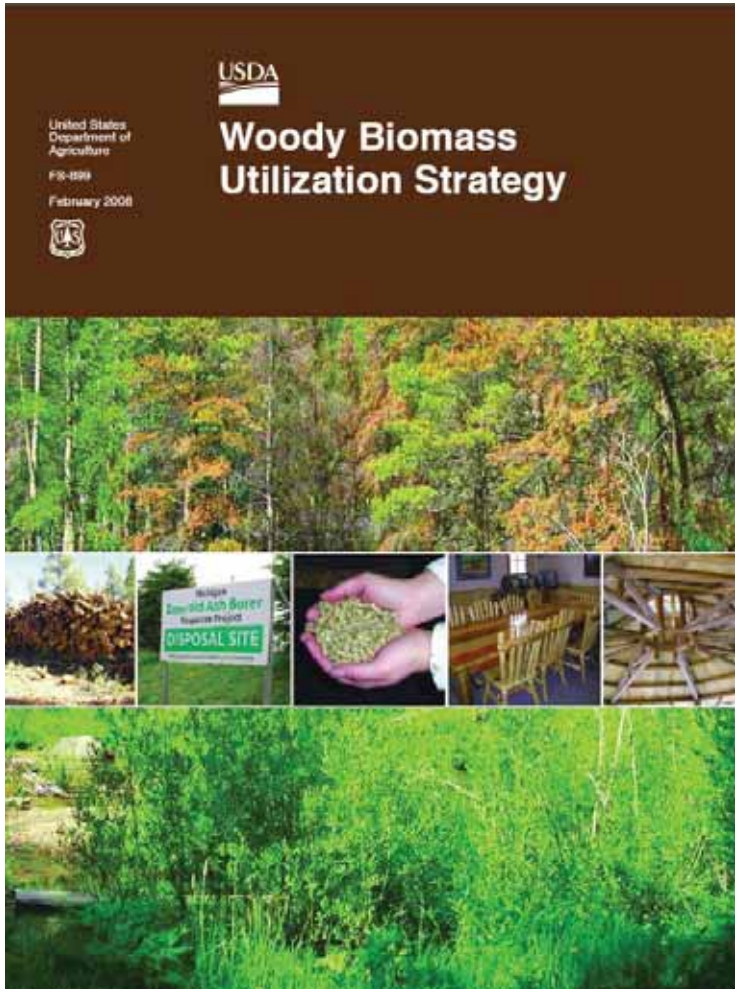
- WBUG definition:
  - "the trees and woody plants, including limbs, tops, needles, leaves, and other woody parts- grown in a forest, woodland, or rangeland environment - that are the **byproducts of forest management**



USFS Nat. Forest System

- Components of interest
  - Aboveground
    - Wood and bark
      - Main Stem
        - » Primary Product
        - » Secondary Product
      - Branches, twigs, & top
      - Stump
    - Foliage
    - Fruit
  - Belowground
    - Stump
    - Roots (course & fine)
- Questions
  - Moisture Content?
  - What is if isn't a tree?

National Direction



- "Our goal to increase the amount of America's energy that comes from forests requires we coordinate to improve the **use of woody biomass** in tandem with forest management activities on public and private lands"

  Abigail R. Kimbell

- Important for
  - commercial uses (e.g., fiber and **fuel**),
  - scientific studies of ecosystem productivity,
  - energy and nutrient flows, and
  - assessing the contribution of land-use on the **global carbon cycle**

Patton-Mallory, Marcia, ed. 2008. Forest Service, U.S. Department of Agriculture woody biomass utilization strategy. Washington, DC: U.S. Department of Agriculture, Forest Service. 17 p.

How NBEL started

- Changing management priorities/markets
- Renewable/sustainable energy
- NFS need for weight equation library
- 1000's of equations
- Need "simple" weight estimate
- Carbon estimates (FVS, Academia, Silviculture)
- We collected literature, synthesized and created the NBEL

National Biomass Estimator Library

FIA and FMSC recognized a need for:

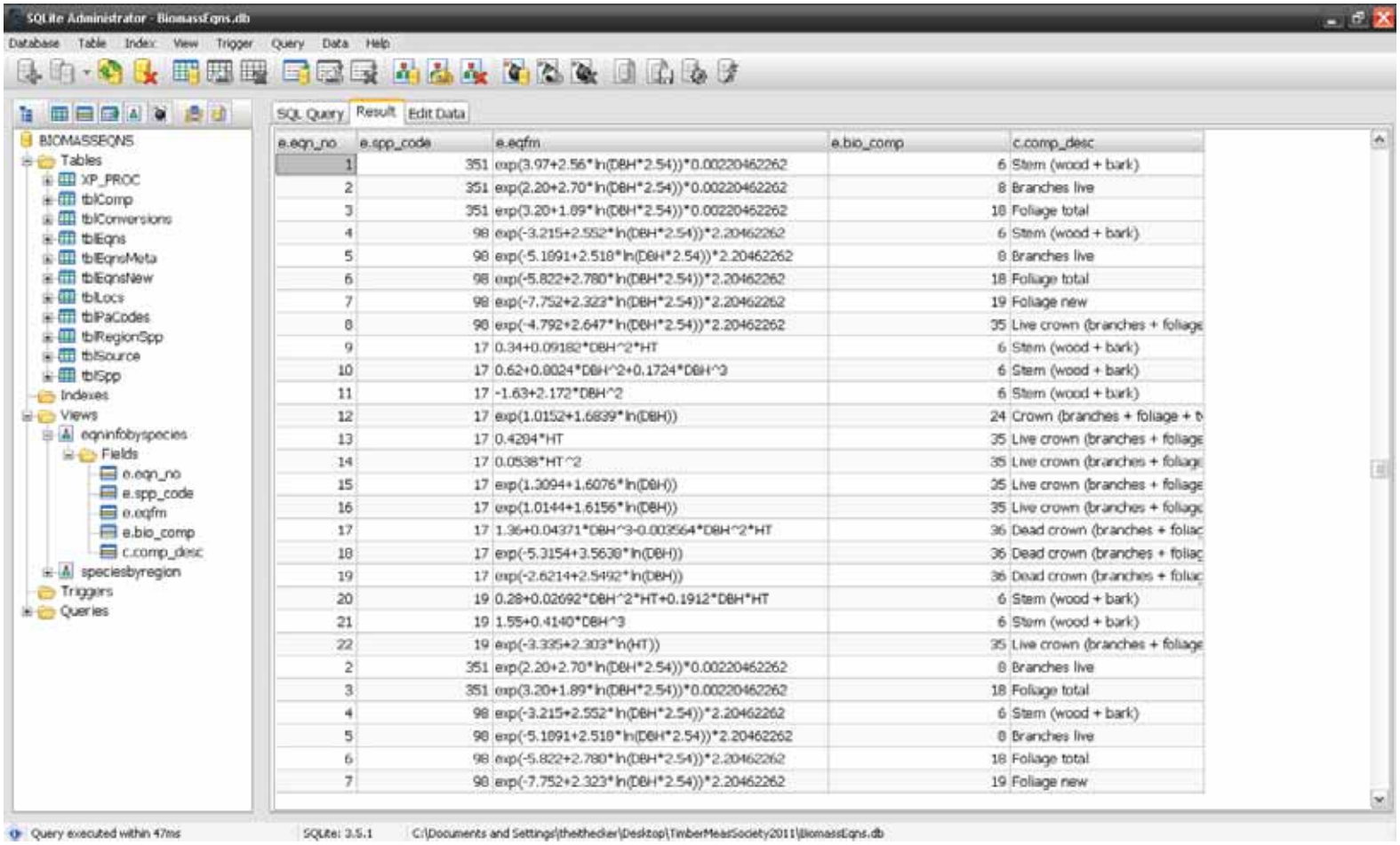
- Consistency and validation of current and future estimators
- Inter-agency cooperation
- Tech transfer and ease of use (tools)
- Complex Issue
  - Variable products, entities and equations
- BUT, where are we now?

Where we are now

- SQLite database
- ~400 equations
- >300 species
- ~180 citations
- DBH, HT, CR
- MS Excel Add-in
- .dll
- muparser solves!

Accessing NBEL

- Via SQLite Administrator
- This is the actual database



e.eqn_no	e.spp_code	e.eqfm	e.bio_comp	c.comp_desc
1	351	exp(3.97+2.56*ln(DBH*2.54))*0.00220462262	6	Stem (wood + bark)
2	351	exp(2.20+2.70*ln(DBH*2.54))*0.00220462262	8	Branches live
3	351	exp(3.20+1.89*ln(DBH*2.54))*0.00220462262	18	Foliage total
4	98	exp(-3.215+2.552*ln(DBH*2.54))*2.20462262	6	Stem (wood + bark)
5	98	exp(-5.1891+2.518*ln(DBH*2.54))*2.20462262	8	Branches live
6	98	exp(-5.822+2.780*ln(DBH*2.54))*2.20462262	18	Foliage total
7	98	exp(-7.752+2.323*ln(DBH*2.54))*2.20462262	19	Foliage new
8	98	exp(-4.792+2.647*ln(DBH*2.54))*2.20462262	35	Live crown (branches + foliage
9	17	0.34+0.09182*DBH^2*HT	6	Stem (wood + bark)
10	17	0.62+0.0024*DBH^2+0.1724*DBH^3	6	Stem (wood + bark)
11	17	-1.63+2.172*DBH^2	6	Stem (wood + bark)
12	17	exp(1.0152+1.6839*ln(DBH))	24	Crown (branches + foliage + b
13	17	0.4204*HT	35	Live crown (branches + foliage
14	17	0.0538*HT^2	35	Live crown (branches + foliage
15	17	exp(1.3094+1.6076*ln(DBH))	35	Live crown (branches + foliage
16	17	exp(1.0144+1.6156*ln(DBH))	35	Live crown (branches + foliage
17	17	1.36+0.04371*DBH^3-0.003564*DBH^2*HT	36	Dead crown (branches + foliac
18	17	exp(-5.3154+3.5638*ln(DBH))	36	Dead crown (branches + foliac
19	17	exp(-2.6214+2.5492*ln(DBH))	36	Dead crown (branches + foliac
20	19	0.28+0.02692*DBH^2*HT+0.1912*DBH*HT	6	Stem (wood + bark)
21	19	1.55+0.4140*DBH^3	6	Stem (wood + bark)
22	19	exp(-3.335+2.303*ln(HT))	35	Live crown (branches + foliage
2	351	exp(2.20+2.70*ln(DBH*2.54))*0.00220462262	8	Branches live
3	351	exp(3.20+1.89*ln(DBH*2.54))*0.00220462262	18	Foliage total
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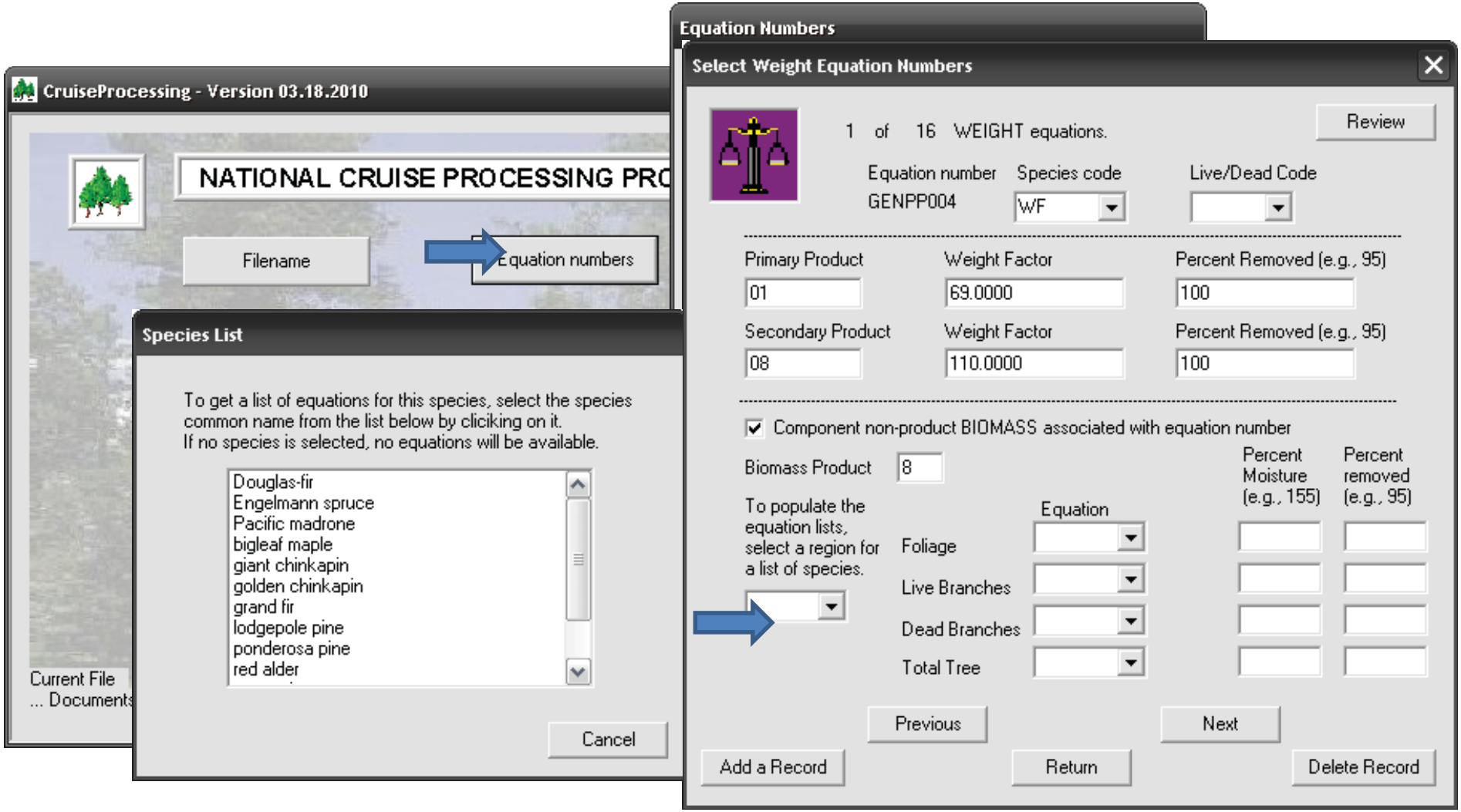
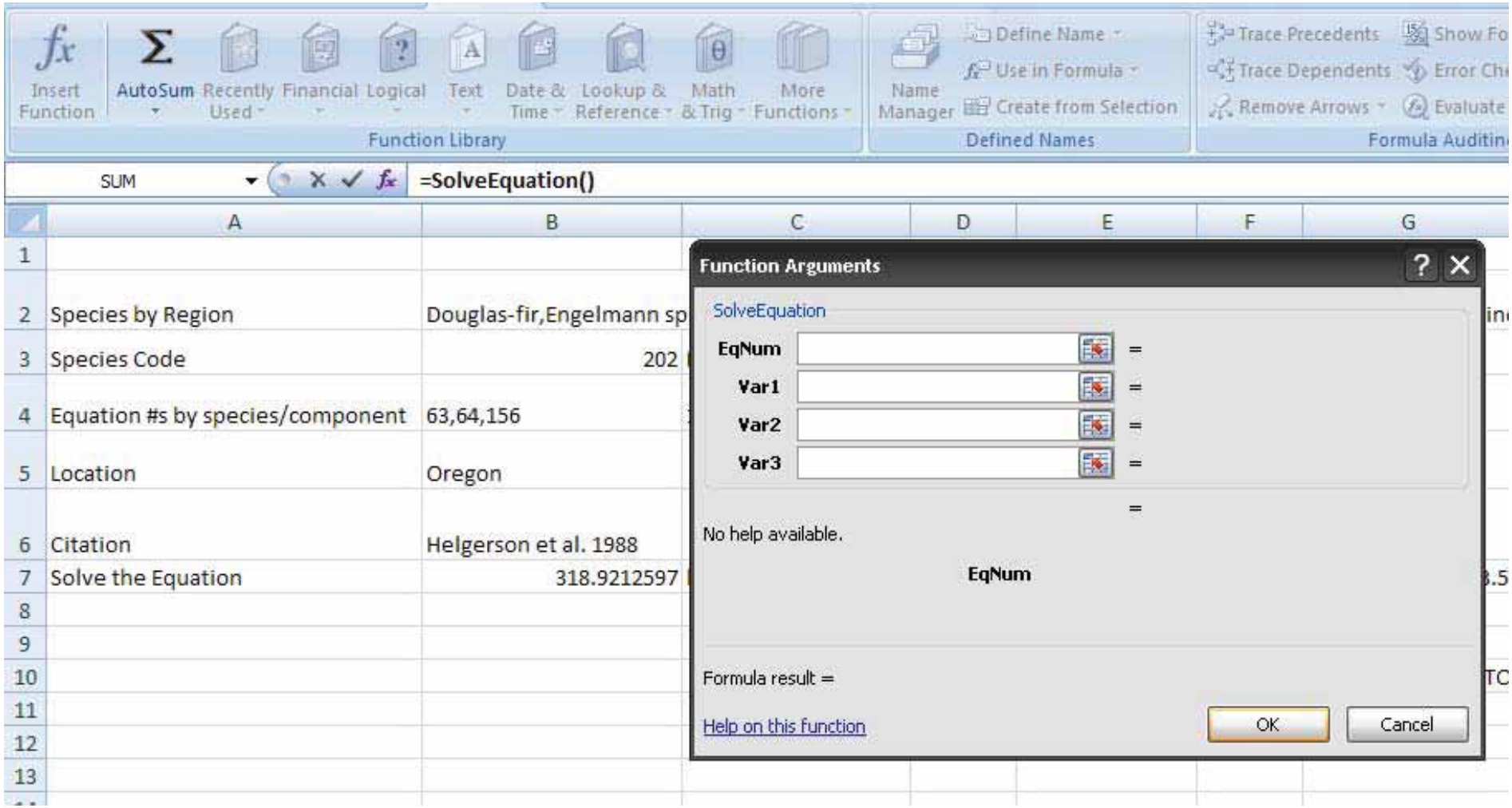
Accessing NBEL

Via Cruise Processing



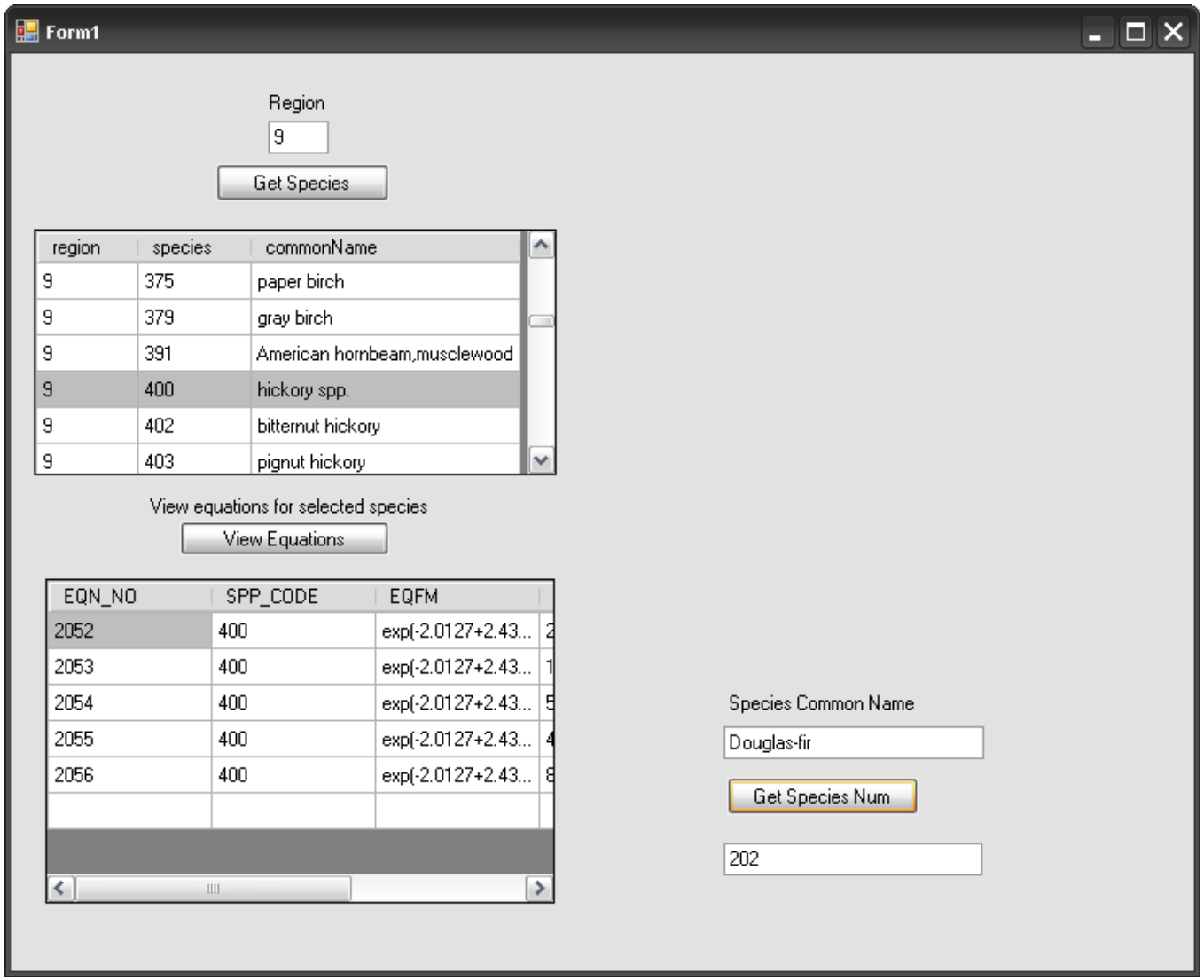
Accessing NBEL

- Via Excel Add-in



Accessing NBEL

Simple testing programs.



Where we would like to be

- Moisture Contents
  - Woody handbook
  - May need components (just main stem now)
  - Supplement with more studies/data
- Weight Factors
  - Good main stem data
    - Currently used by regions
    - No component data - RBS
  - Not in NBEL…yet
- Local Data
  - Rather than national eqns

How do we (and you) get there?

- Contact us!
- All of our products public domain

Who are we?

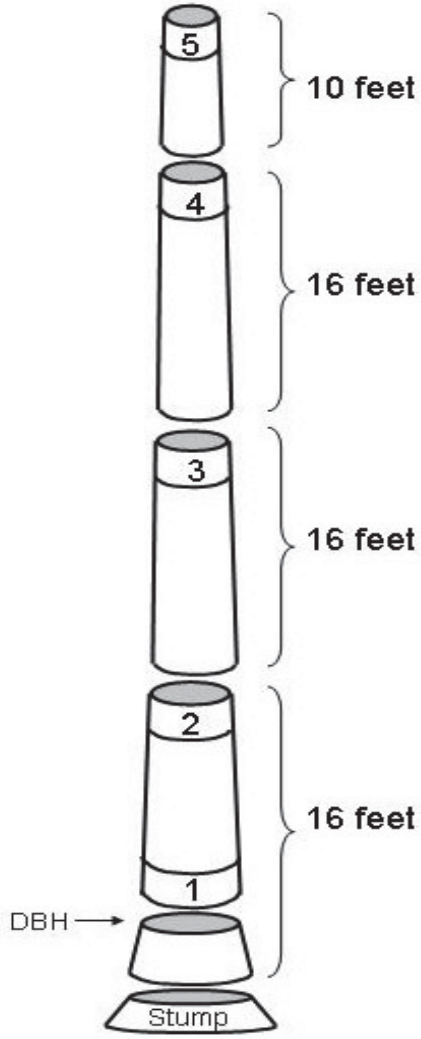
- **Forest Management Service Center**
  - Biometric and mensuration specialists
  - Tech. transfer, national directions, and collaboration
  - Responsible for:
    - Forest Vegetation Simulator (FVS)
    - National Cruise System (NCS)
    - National Volume Estimator Library (NVEL)
    - National Biomass Estimator Library (NBEL)
- Well suited to tackle these issues
  - We've done it before!

Weight Factors

- Weight factors
  - **BEF: Biomass Expansion Factors**
- Sources of weight factors
  - Existing tables and publications, historical data
  - Traditional stick scale with load weight
  - Xylodensimeter
  - Scaling and weighing “chunks” of trees in the field

Segmentation for Weight Factors

- Fell the tree
- Divide tree into 16 foot logs
- Select 2-foot section at top of each log and DBH
- Weigh each section
- Determine cubic volume for each section
- Weight Factor is total weight/total volume

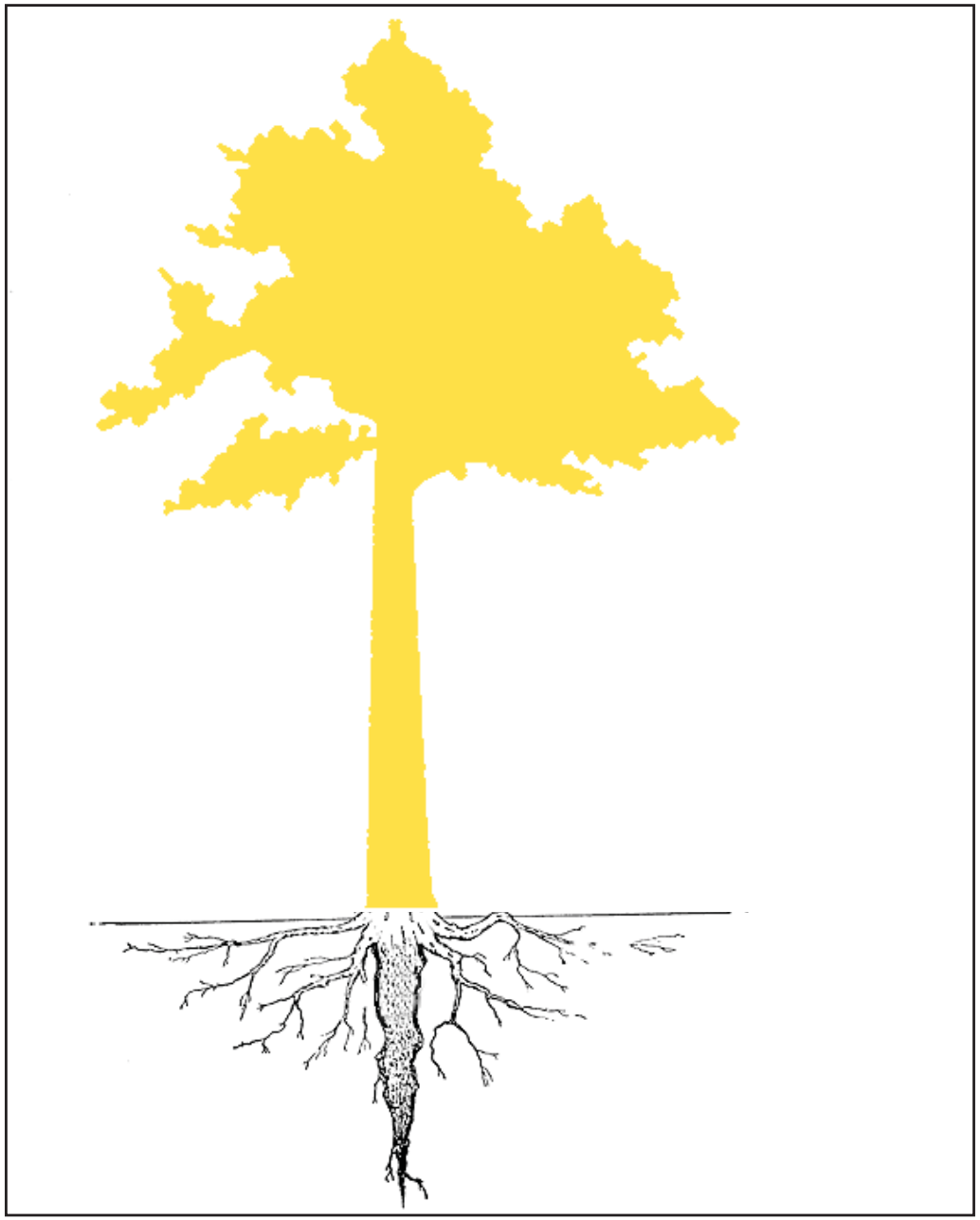


Whole-Tree (Estimates?)

Exactly what it sounds like…

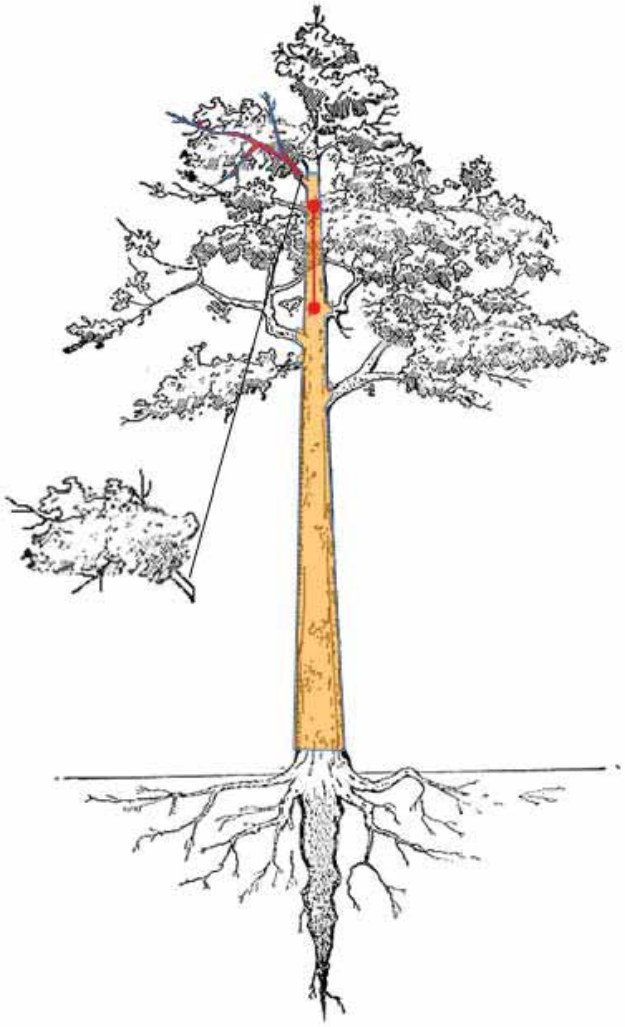
Whole-Tree Methods

1. Fell the tree
2. Parse components
3. Weigh and repeat as needed



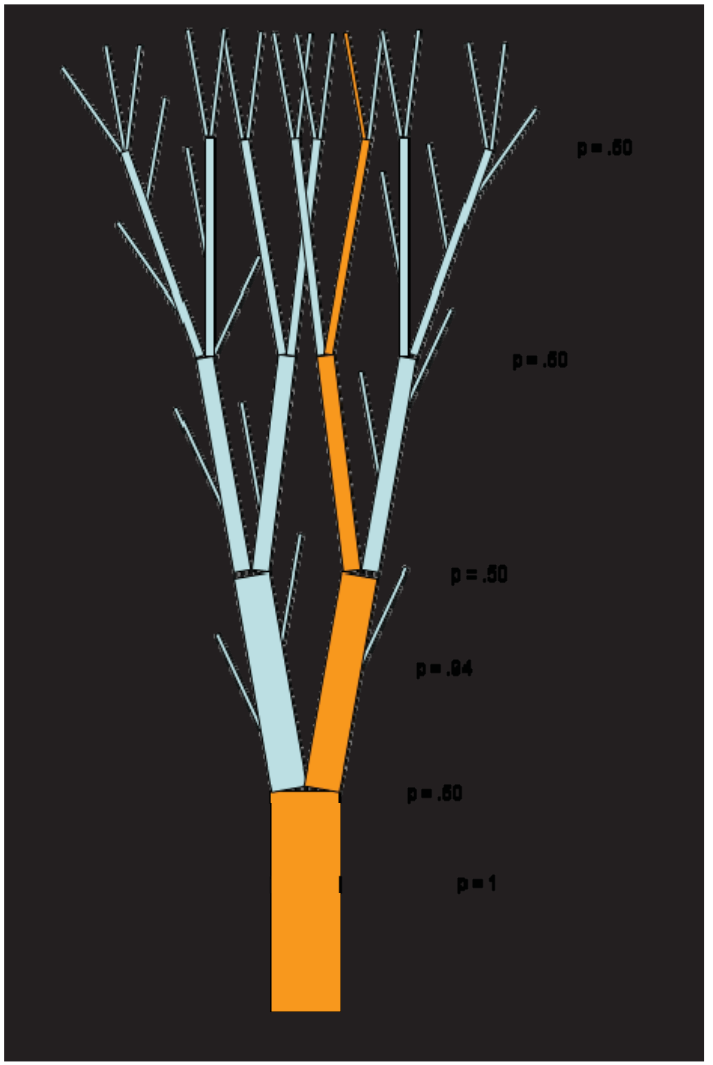
Randomized Branch Sampling

- Jessen (1955) estimating fruit counts
- Fell tree
- Select branch as follows:
  - Measure diameter of branches
  - Measure the diameter of bole
  - Sum the squares of the diameters
  - Random number between 1 and SS diameters.
  - Select branch or main bole



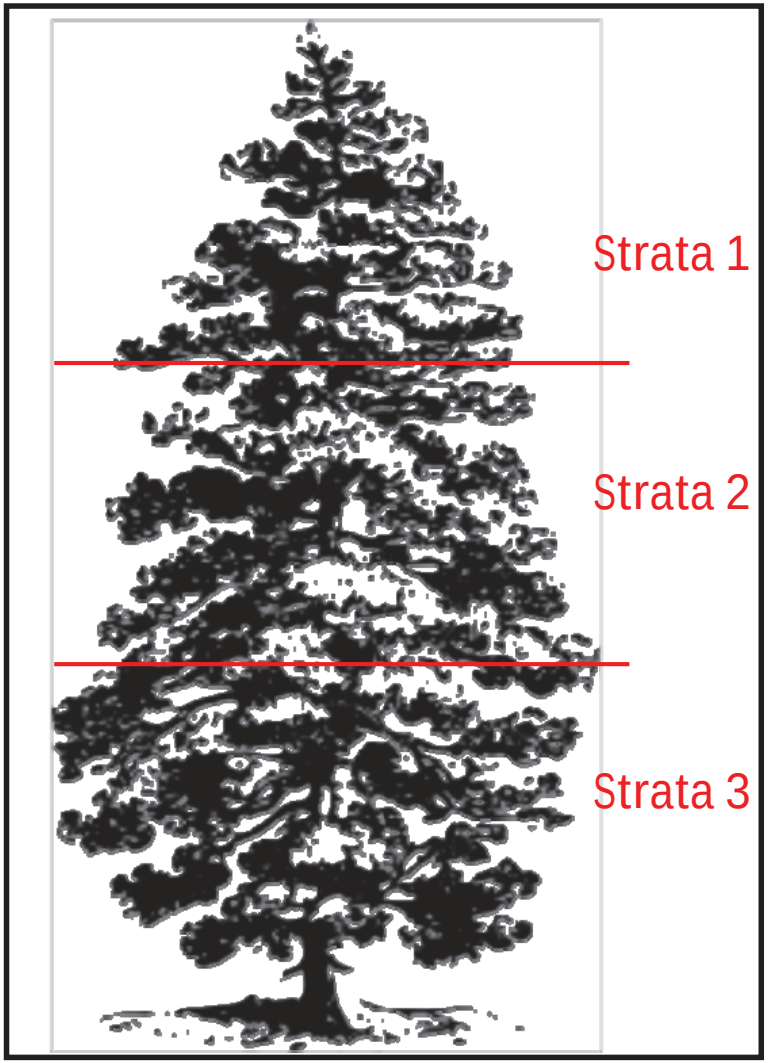
Randomized Branch Sampling

- Select branch as follows (cont.):
  - If main stem selected, move to next branch
  - If branch selected, remove branch, divide branch into components, weigh components
  - Branch components expanded back to tree using product of probabilities
  - Can oven dry components



Stratified Randomized Branch Sampling

- Similar to previous but:
- Divide crown into strata (3+)
- Measure diameters of all branches in strata and sum the square
- Use List Sampling to select branch from strata
- Remove branch, divide branch into components, weigh components
- Branch components expanded back to strata using probability of selection
- Can oven dry the components
- Advantages?



Conclusions

- How NBEL started
- Where we are.
- Where we want to go.
- How we can get there.

Questions?

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