6.0 Assessing Stand Attributes

COMMUNITY –

Any assembly of organisms living together, no particular ecological status being implied.

STAND –

A community, particularly of trees, possessing sufficient uniformity as regards composition, constitution, spatial arrangement, or condition, to be distinguishable from adjacent communities, so forming a silvicultural or management entity, e.g., as a sub-compartment. In some countries there is an arbitrary area minimum.

CONSTITUTION – [of a forest stand or crop]

The distribution and representation of age and/or size classes, i.e., structure.

6.1 Stand Attribute Description

AGE –

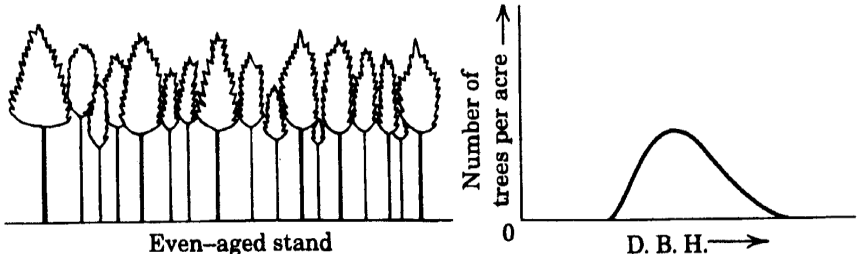
Trees in Northern temperate zones grow a distinctive layer of wood each year, so age is found by counting annual rings as viewed in cross-section of the tree trunk.

Total –Elapsed time (years) since germination of seed or time since budding of a sprout or cutting.

Breast Height Age – elapsed time (years) since tree attained breast height (4.5 ft).

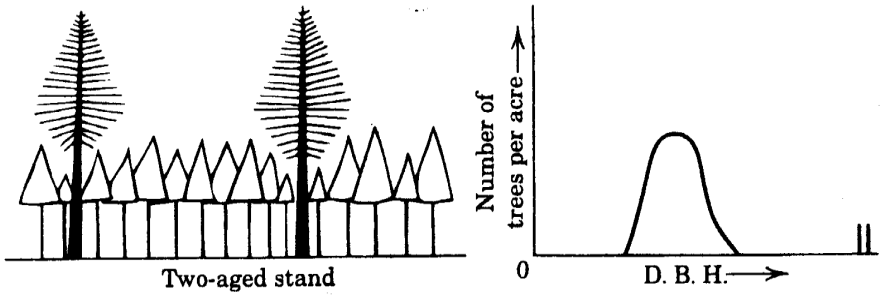
Plantation Age – commonly measured as elapsed time since planting – excludes age of seedlings.

Even-aged stands – Those stands in which tree ages do not vary more than 10 – 20 years (or by more than 10 – 20% in very old stands). In effect, the stand became established after a single, stand-replacing disturbance.

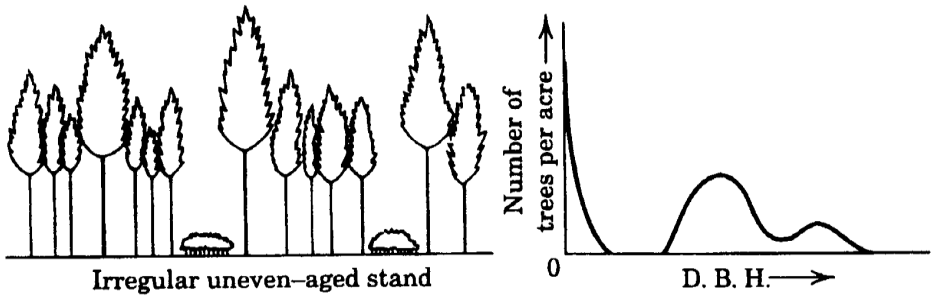


Uneven-aged stands – Those stands in which tree ages vary more than the previously stated range for even-aged stands.

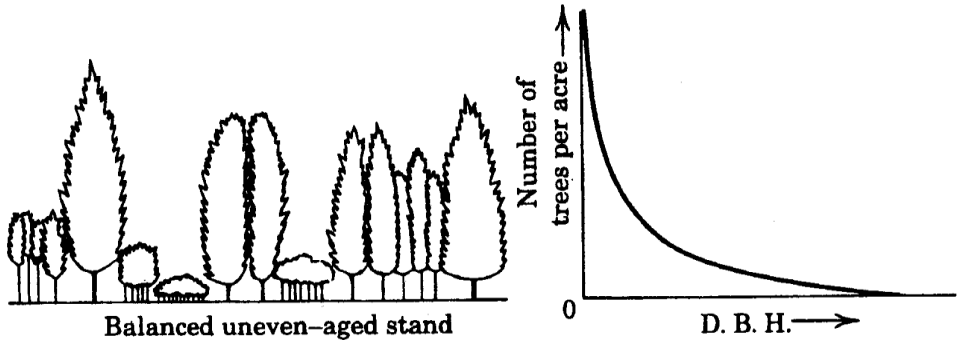
Two – aged:



Multi – aged:



All – aged:



STAND DENSITY – NUMBER OF TREES PER ACRE (TPA) –

The most basic measure of stand density. In natural even-aged stands, number of seedlings germinating after a disturbance can be highly variable in both space and time but can be quite high (10,000 to 30,000 trees per acre). However, mortality rates in newly germinated seedlings can also be very high. In plantations, mortality rates after planting will depend on the quality of the planting stock and the planting job, and the amount and type of competing vegetation and animal populations. In both cases, once the seedlings have become well established, mortality rates are usually low until the trees develop to the point where they start to compete with each other. At this point, competition induced mortality will start and number of trees per acre will decline.

SPECIES COMPOSITION –

Typically this is represented by proportion of each species present in a stand. May be based on number of individuals (most often in ecological studies), basal area of all trees (most often for mensurative purposes), or volume of all trees (less often).

Importance value – from an ecological and community function perspective, species composition has three components: frequency, abundance, and dominance. Frequency refers to the number of sampling units, n, in which the species is found. Abundance refers to the number of individuals, d, in the population. Dominance refers to the size of individuals, x, in the population.

Importance, I, is calculated as in the following:

$$I_j = \left(\frac{n_j}{N} + \frac{d_j}{D} + \frac{x_j}{X} \right),$$

where,

N = total number of sampling units,

D = total number of individuals,

X = total of the size parameter for the population.

STAND DIAMETER –

Average DBH of trees in the stand. This average can be expressed as either the arithmetic mean or the quadratic mean.

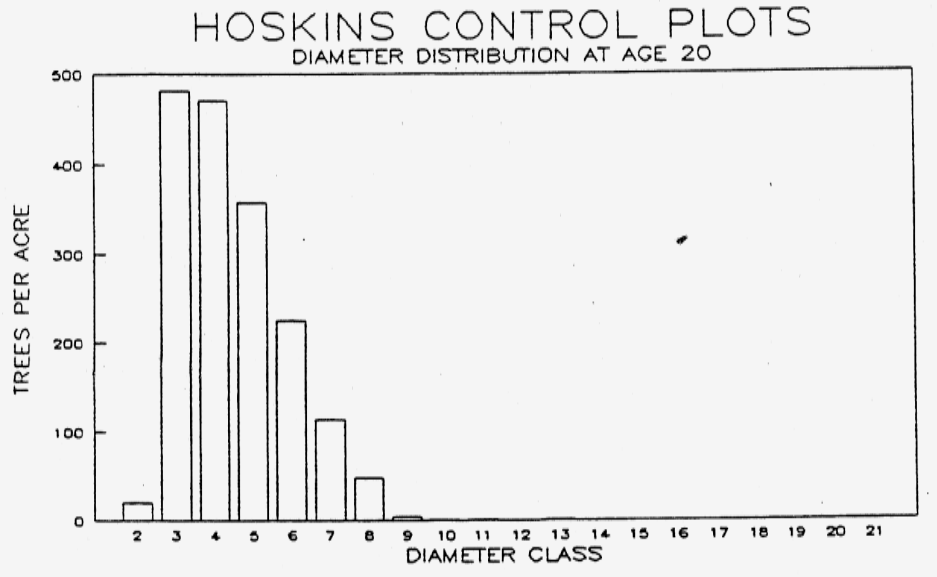
Arithmetic Mean DBH – The simple average DBH of all trees in the stand.

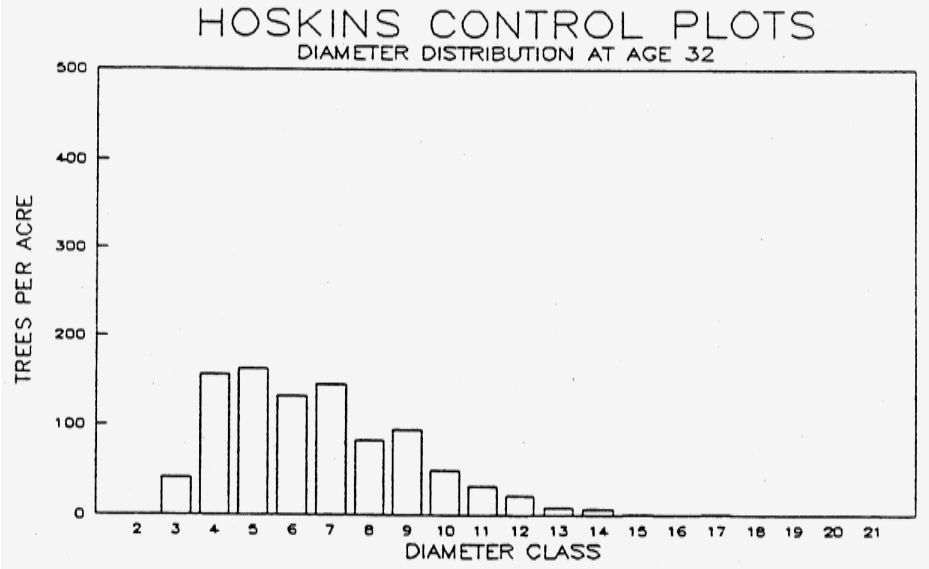
$$\bar{d} = \frac{\sum_{i=1}^{n} DBH_i}{n}.$$

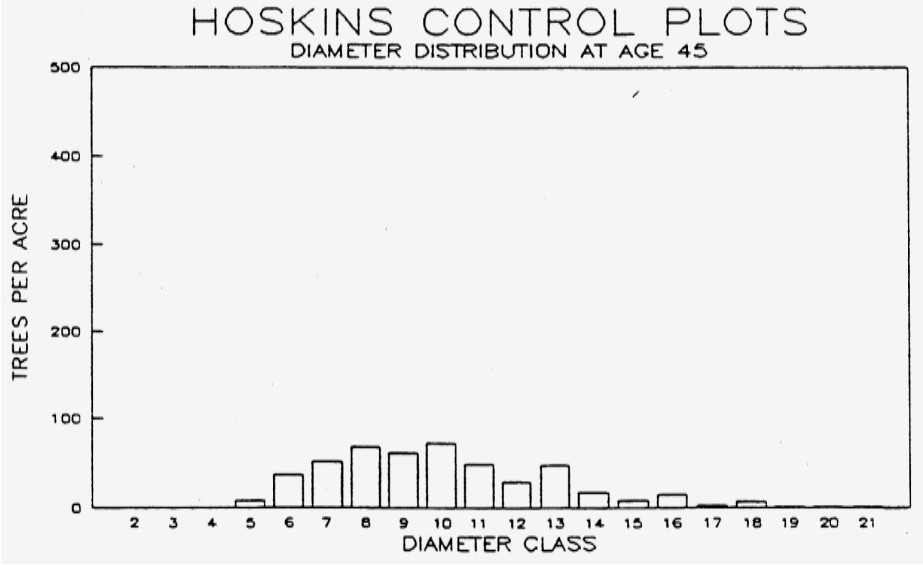
Quadratic Mean DBH (QMD) – More appropriately used for calculating stand basal area, volume, and biomass.

$$QMD = \bar{d}_Q = \sqrt{\frac{\sum_{i=1}^{n} DBH_i^2}{n}}$$

Diameter Distribution – Usually characterized as the number of trees per acre in one or two inch diameter classes in a frequency histogram or in a *Stand Table*. Information from the stand's diameter distribution is used to characterize the stand's structure and is often used to characterize within stand competition.


HOSKINS CONTROL PLOTS
DIAMETER DISTRIBUTION AT AGE 20
TREES PER ACRE
0
100
200
300
400
500
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
DIAMETER CLASS


HOSKINS CONTROL PLOTS
DIAMETER DISTRIBUTION AT AGE 32
TREES PER ACRE
0
100
200
300
400
500
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
DIAMETER CLASS


HOSKINS CONTROL PLOTS
DIAMETER DISTRIBUTION AT AGE 45
TREES PER ACRE
0
100
200
300
400
500
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
DIAMETER CLASS

STAND BASAL AREA –

The total basal area (cross-sectional area of a tree at breast height) of all individual trees. Basal area is related directly to volume, biomass, and is also a basis for the measurement of stand density and competition.

$$G = n \times 0.005454 QMD^2 = 0.005454 \sum_{i=1}^{n} DBH_i^2$$

Basal area can be expressed as both a net and a gross value.

STAND HEIGHT –

Widely used as a measure of site quality and stand productivity. Vertical structure as revealed in the height distribution is an important factor in many silvicultural prescriptions and in assessing wildlife habitat.

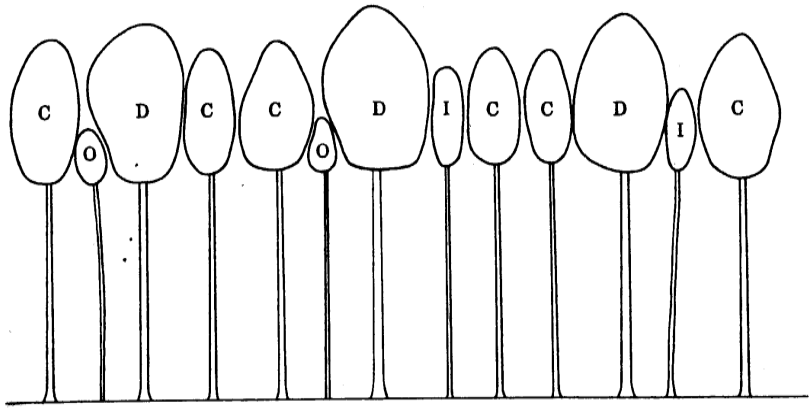
Height classification – Vertical structure may be described numerically using actual heights or may be based on crown position (height hierarchy):

Dominant – Crowns extend above the general level of the canopy of others in the same stratum and are not physically restricted from above, though may possibly be somewhat crowded on sides.

Codominant – Crowns form a general level of canopy stratum and are not physically restricted from above, but are crowded somewhat from sides.

Intermediate – Generally shorter trees, but crowns extend into the general level of the dominant and codominant trees, free from physical restriction above, though quite crowded on the sides.

Overtopped (suppressed) – Crowns are entirely below the general level of dominants and codominants and are physically restricted from above.



Average Height – Simple arithmetic mean height of all trees in the stand.

$$\bar{H} = \frac{\sum_{i=1}^{n} h_i}{n} \quad OR \quad \bar{H} = \frac{n_1 h_1 + n_2 h_2 + \cdots + n_z h_z}{n} = \frac{\sum_{j=1}^{z} n_j h_j}{\sum_{j=1}^{z} n_j}$$

where, n denotes total number of trees per unit area.
h_i denotes average height of an individual tree,
n_j denotes number of trees in diameter class j,
h_j denotes average height of trees in the j *th* diameter class,

Lorey's Height (H_L) – Mean height of the stand weighted by tree basal area:

$$H_L = \frac{\sum_{i=1}^{n} g_i h_i}{G} = \frac{g_1 h_1 + g_2 h_2 + \cdots + g_n h_n}{G}$$

where, G denotes total basal area per unit area,
g_i denotes basal area of *i th* tree or avg. basal area for diameter class,
all other variables as before.

Dominant Height – The average height of dominant trees. May be average height of dominant and codominant trees. Dominant trees can be defined in many different ways, and this leads to different measures of dominant height.

Top Height – In European literature, top height is the average height of the 100 largest diameter trees per hectare in the stand. In the US, this usually has been translated to be the 40 largest diameter trees per acre in the stand. It is often abbreviated using the symbol H40.

$H_{80\%}$ – Average height of trees at and above the 80th percentile of the diameter distribution.

SITE QUALITY –

Describes the inherent capability of the land to produce primary products or timber, usually wood volume, i.e., to grow trees of a particular species.

Integrates edaphic factors (nutrients, water holding capacity, rooting depth, texture, etc.), climatic factors (daytime temperature, nighttime temperature, amount and timing of rainfall, humidity, solar radiation, length of growing season, etc.), and geographic and other important factors affecting tree growth (elevation, aspect, slope, etc.)

Site – may be defined as "an area considered in terms of its environment, particularly as this determines the type and quality of the vegetation the area can carry" (Ford-Robertson 1983).

Site Type – is a classification by climate, soil, vegetation, topography (perhaps other measures), and is a qualitative metric.

Site Class – is determined by some quantitative measure of site potential to produce primary products (most typically, a range of Site Index values).

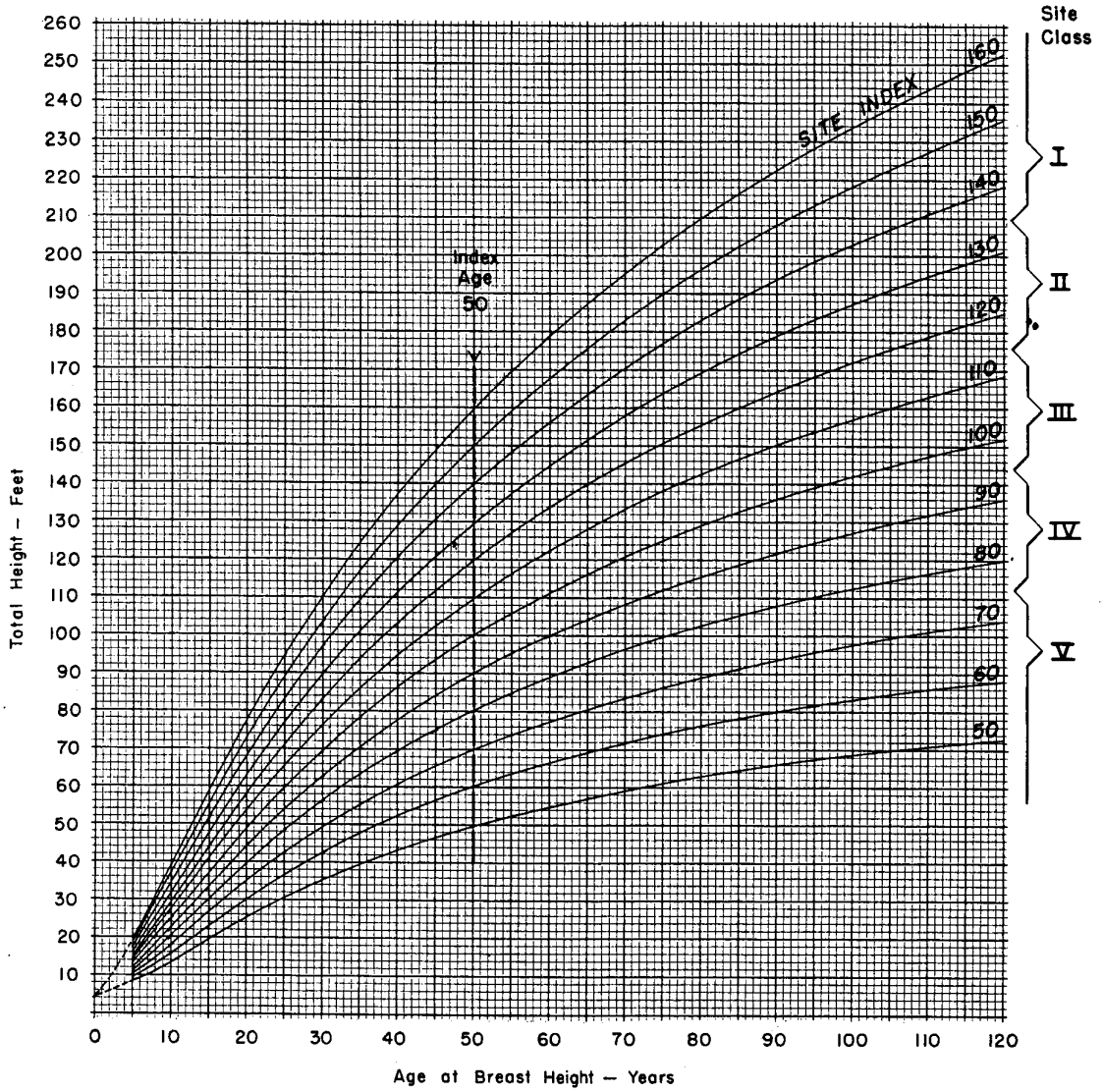
Site Index - A measure of site class based on the height of the dominant trees of a particular species in a stand at an arbitrarily chosen age (Ford-Robertson 1983).

Base Age - The reference age chosen for determining site index. Also known as index age. Can be expressed as total age, breast height age, or stand age in years. The base age is often set near mid-rotation age for the species under consideration. Common ages for the western United States are 30, 50 or 100 years.

Site Index Equation - A site index equation predicts site index from a given age and its corresponding dominant height. Dominant height can be defined variously as can age. Depending on the equation, these input variables can be either for individual trees or averages for the stand.

$$S_{50} = 4.5 + \frac{274.3925 + 19.8059(A) + 0.494233\left(A^2\right)}{0.954038 - 0.0558178(A) + 0.000733819\left(A^2\right) + \frac{A^2}{H_D - 4.5}}$$

The reason that knowing site index is important (especially from a growth and yield perspective) is not so much in knowing the number itself, but it "indexes" the appropriate dominant height equation so that height growth can be forecasted.



From: King, J.E. 1966. Site index curves for Douglas-fir in the Pacific Northwest. Weyerhaeuser Forestry Paper, No. 8, Weyerhaeuser Co., Forestry Research Center, Centralia, WA.

Dominant Height Equation - A dominant height equation predicts dominant height from age (either total, breast height, or stand age) and site index. Depending on the equation, age and site index values can be for individual trees or averages for the stand.

Summary Points

1. Terms to remember: community, stand, constitution, crown class (dominant, co-dominant, etc.), density, QMD, Top Height (H40), Lorey's Height, site index, site index equation, dominant height equation
2. Stand structure can be based on species composition, DBH distribution, Height distribution, proportions of crown classes present, or other things or combinations thereof
3. Stand structure is also influenced by basal area, crown closure, stand density, and site quality
4. The most basic measure of stand density is number of trees per unit area (usually an *acre* in the U.S.), but other very useful indexes for density (crowding of individuals) exist, such as Stand Density Index (SDI), Relative Density (RD), Crown Competition Factor (CCF), etc.
5. Site index is the cornerstone of site quality evaluation (productivity assessment) in the United States of America