Evaluating Hardwood Stands Following Storm Damage

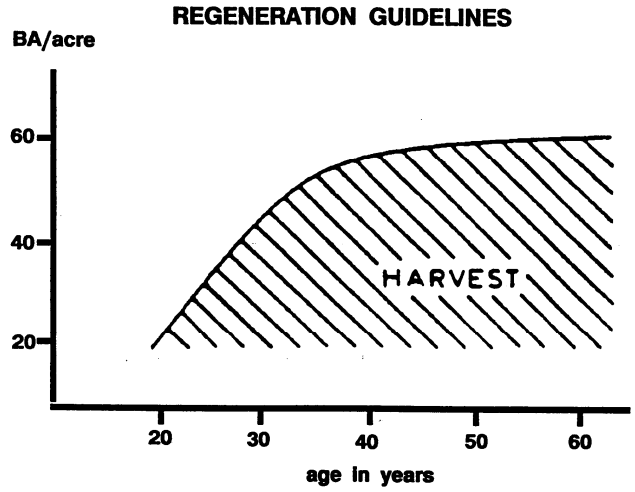
A proper stand assessment or evaluation following storm damage should be made so that the necessary stand prescription and treatment can be applied. Important information needed for stand assessment may include the following:

- Percent Stocking of Residual Stand
- Stand Quality
- Extent of Damage
- Regeneration Potential

Depending on the extent of storm damage, oftentimes landowners are left with hardwood stands where the density of larger, mature trees have been reduced or blown over. A frequently asked question as it relates to timber management is "Is there enough of a hardwood stand present to manage for the future?"

A forest manager must be able to make tough decisions when understocked hardwood stands are encountered. If the hardwood stand is marginally understocked, the manager may not be able to plan any intermediate harvests in the near future. If the stand is severely understocked in desirable growing stock, the manager may decide to regenerate the stand.

Kellison and others (1981) provided a general guide to identify insufficient stocking of even-aged stands.



Using this guide, a **minimum of 20, 40, and 60 square feet of basal area at 20, 30, and 40 years** is required to justify carrying the stand forward. Stands with very low stocking are candidates for harvest and regeneration. One drawback of this guide is it only uses basal area and does not consider the number or size of the trees.

The use of stocking guides may also be helpful to determine if a hardwood stand is adequately stocked with trees. Stands adequately stocked to carry the present stand to rotation age will contain about the following number of crop trees.

Size*	Number of trees
6	200-340
8	140-240
10	90-150
12	70-115
14	50- 90
16	40-100
18	35- 60
20	30- 50

* Diameter, in inches, measured 4 1/2 feet above the ground.

This table is merely a guide and does not require that all the trees must be outstanding in quality and form. All classical estimates of stocking provide an aide to keep a stand within reasonable limits of stand density, however none provide a solution to identifying the best stand density management regime for a given stand (Goelz 1997b).

Stand density is a quantitative measure of a stand in terms of square feet of basal area, number of trees, or volume/acre. **Stocking** is a qualitative term referring to the degree of adequacy of the stand condition to meet a timber management objective.

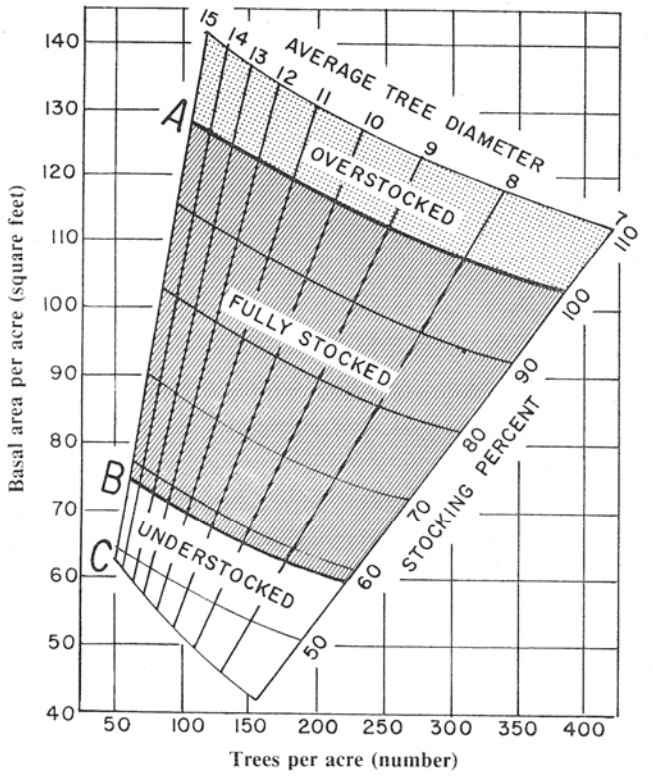
When assessing stocking, the forest manager needs to distinguish between desirable or acceptable growing stock (AGS) and undesirable growing stock (UGS). Undesirable growing stock includes trees of non-merchantable species, poor log quality or grade, and very low tree vigor.

Stocking Guides are useful to help determine percent stocking and stand conditions that identify insufficient stocking, adequate stocking, and overstocking.

Upland Hardwoods

Maintaining the stand at the lowest stocking that fully utilizes the growing space will lead to the fastest diameter growth possible for that particular stand. This B-line on a stocking chart represents suggested residual stocking after thinning, or minimal full stocking. In storm damaged stands, the forest manager needs to know where the current stand falls in relation to this B-line and the C-line.

Below is a stocking guide that was developed by Gingrinch (1967) for upland hardwoods.



Gingrich's stocking guides are used to determine whether existing stands have (1) sufficient basal area in growing stock trees to carry through rotation, or (2) whether the stands should be regenerated.

The **C-level of stocking** is used as a minimum of basal area required to carry existing stands. Stands at the C-level of stocking will fully occupy the site in an average of 10 years on medium quality sites.

Table 1.—Acceptable stocking levels for various average tree diameters

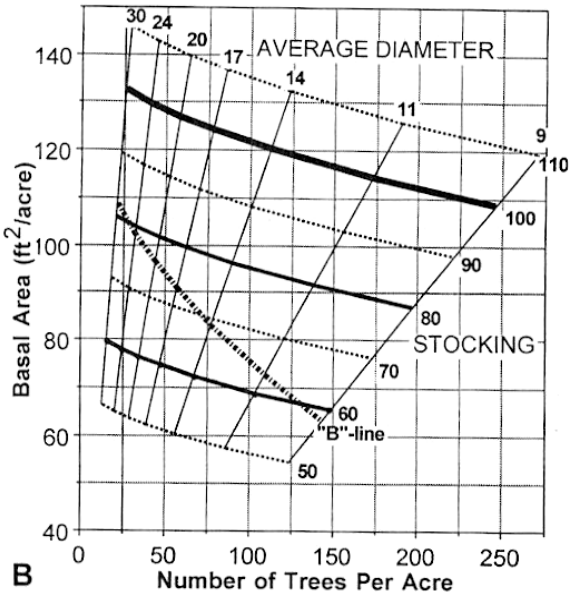
Average tree dia.	*Basal Area C level stocking*	*Basal Area [1] B level stocking*
inches	square feet	square feet
3	24	38
4	28	47
5	34	53
6	38	57
7	43	60
8	46	62
9	50	65
10	53	67
11	55	69
12	57	71
13	59	72
14	61	73
15	62	74
16	63	75
17	64	76
18	65	77

As a general rule for managed stands, trees in the main size class should contain 50 percent or more of the total basal area. Another guide is that these trees should contain enough acceptable growing stock for C-level stocking.

Bottomland Hardwoods

Goelz (1995) provided a stocking guide for use in southern bottomland hardwoods. The B-line is based on the suggested residual stocking of Putnam (1960) rather than on minimum full stocking. The stocking guide applies to mixed southern bottomland hardwoods of good to excellent site quality. This includes cherry bark oak SI>90, and sweetgum SI>85. It has limited use for riverfront hardwoods or for stands of low site quality.

B. Stocking guide for southern bottomland hardwoods.



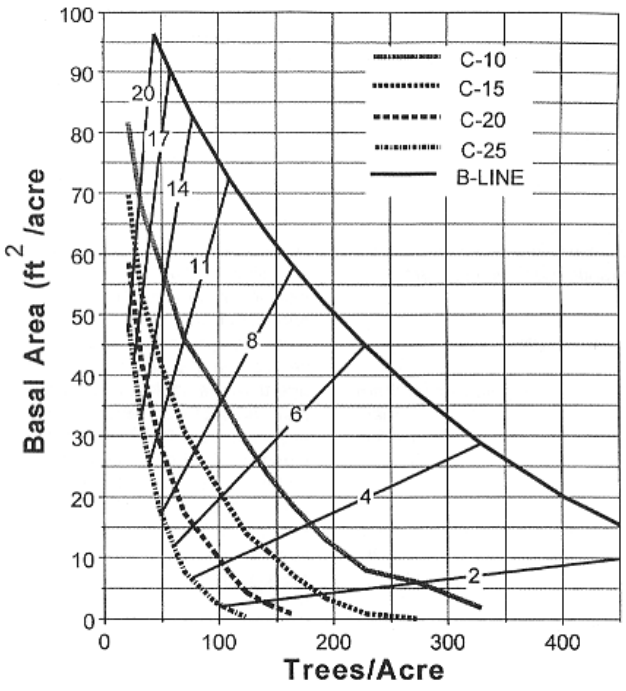


Table 2- Acceptable stocking levels for various tree diameters for bottomland hardwoods

Avg. Tree DBH (inches)	Basal Area C-10 level stocking (square feet)	Basal Area B-level stocking (square feet)
4	15	28
6	26	45
8	35	57
10	43	70
12	50	75
14	55	83
16	60	86
18	66	92
20	70	96

The C-lines in stocking charts may be used to identify stands of low density. Some stands may be left for various wildlife, riparian, or aesthetic objectives. When the decision is made to maintain a low-density stand rather than regenerate it, tree value will be below the potential of the site and species because merchantable heights are shorter, branches are larger, and grade of trees is poorer when grown at very low stocking (Goelz 1997b).

The above figure was developed by Goelz (1997a) and presents 4 C-lines of stocking for southern bottomland hardwoods along with the B-line. Alternative C-lines may be used to determine different silvicultural opportunities – the C-line based on 10 years may be used to identify stands that do not require intervention in the near future; a C-line based on 20 years may be used to identify stands requiring regeneration.

The C-20 line may be appropriate to use to identify stands of such deficient stocking as to require regeneration since it would take a long period of time to achieve the B-line of minimum full stocking.

In storm damaged areas, the forest manager may encounter stands that are nearly mature but poorly stocked. Some stands may have even been disturbed in the past from previous cutting. If they contain acceptable growing stock adequate to meet C-level requirements, they can be left to grow. More often, however, timber quality is apt to be low and acceptable growing stock is limited. A careful examination will need to be made on the residual trees in the stand to determine tree/log quality and whether the majority of residual trees are good candidates to leave for the next harvest.

Table 3. A key to choosing a silvicultural practice

Stand is less than 10 years from rotation age.
1) Plan regeneration when appropriate.

Stand is more than 10 years from rotation age

I. Stocking is ≤ 100%.

Stocking of Acceptable Growing Stock (AGS) ≥ C-10 line.
2) Do nothing.

Stocking of Acceptable Growing Stock (AGS) ≤ C-10 line.
Quadratic mean DBH of AGS ≥ 16”
3) Consider regeneration

If the Quadratic mean DBH of AGS <16”
Stocking of AGS < C-20 line
4) Consider regeneration

Stocking of AGS ≥ C-20 line
Whole stand stocking is > the B-line
5) Consider Timber Stand Improvement
Whole stand stocking is ≤ the B-line
6) Do nothing

II. Stocking is ≥ 100%

Stocking of Acceptable Growing Stock (AGS) ≥ B-line
7) Consider thinning

Stocking of AGS ≤ B-line
Stocking of AGS ≥ C-10 line
8) Timber Stand Improvement

Stocking of Acceptable Growing Stock
(AGS) < C-10 line
Stocking of AGS > C-20 line
QMD of AGS ≥ 16”
9) Consider regeneration

QMD of AGS < 16”
10) Timber Stand Improvement

Stocking of AGS < C-20 line
11) Consider regeneration

Stand Quality

The first step in evaluating a stand of trees or individual trees or logs is classifying the trees or logs. It is important for the forest manager to be familiar with log classes and log grades along with defects that reduce tree quality. Some general factors that affect tree quality include size of the diameter, position of the tree log, form class or taper, deviation from normal stem form, and the type of grade defect.

Many good publications have been written on defects in hardwood timber and guides for hardwood log grading. For many, this takes practice and comes with experience. One thing to keep in mind is that log grade does not depend on surface defects alone. Log diameter also has a strong bearing on grade. In general, trees below a dbh of 16 inches are not big enough to have Grade 1 logs regardless of how free they are of surface defects, except for basswood or ash.

The USFS Standard Grades for hardwood factory lumber logs call for evaluating only the three best faces out of four. The poorest face of the log is eliminated. The grade of the log is then determined by the poorest of the three remaining grade faces. The major problem in grading factory lumber logs is to locate clear cuttings. This requires the proper evaluation of surface indicators of defects. The tree grader must look for and be aware of features such as cankers, fruiting bodies or conks, bulges, burls, butt scars, lesions, epicormic branches, and top or stem breakage.

Extent of Damage

In storm damaged stands, a thorough examination should be made of the damage to residual trees and identify grade defects that may keep the trees from being good candidate trees to leave until the next harvest. Degrade will generally translate into some type of stumpage value loss.

Much of the damage from severe storms to hardwood stands occur in the form of blowdown or tops that are broken out. Hardwood trees are seldom killed by breakage.

The major problem is that breaks in the trunk, or large branches (over 3 inches in diameter) permit entry of stain and decay fungi. For hardwoods, trees with broken tops or branches over 3 inches in diameter should be salvaged during the next scheduled harvest if extensive in the main canopy species or product classes.

Many trees can also sustain wounds caused by falling tops, adjacent uprooted trees, and major branch breakage. Each tree's crown vigor and health should be assessed during the timber exam.

In hardwoods, wounds that do not penetrate more than 2 inches into the sapwood and have less than 144 sq. inches of surface area (12x12), will have only localized stain but little decay. Severe and extensive damage to many of the butt logs should be cause for concern and trees with major wounds should be considered for removal during the next scheduled harvest or during salvage operations.

Oftentimes the damage to timber stands can look worse than they really are, until you really survey the extent of the damage. Is the damage concentrated in one section or area? Is the damage evenly distributed throughout the stand? What percent of the stand has considerable damage that would prevent it from reaching rotation age? Is there enough of a residual stand with acceptable growing stock for future products?

In an irregular stand that is poorly stocked or has been understocked for some time, a heavy understory of tolerant species can develop.

However, site preparation to control these undesirable stems can be very expensive and if the total acceptable growing stock is above the C-level, leave the stand to grow. The stocking should build up and gradually shade out much of the understory or you can use selective herbicides to control the unwanted stems. Come back in 15-20 years and take another look.

Regeneration Potential

Prior to any harvest operation, the regeneration potential of the stand should be evaluated. This will give the forest manager some type of prediction of what type of species or problems can be expected before cutting begins.

Good hardwood regeneration can be successful when attention is paid to stand conditions (overstory and understory species), soil/site types, and species composition. Attached in appendix II is a regeneration inventory form with instructions for use in bottomland hardwood stands. This type of survey uses the stocked plot method to calculate if stand regeneration stocking will be acceptable.

The decision of when to harvest can depend on several factors that may include:

- Landowner's objectives and/or time horizon
- Results of stand assessment
- Local timber markets
- Regeneration Potential

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