

Upland Hardwoods: Should I Manage or Regenerate My Stand?



A common misconception is that the hardwood component of Mississippi's forests has been "cut out," leaving only pine-dominated forests for the future. However, hardwoods occupy approximately 8.8 million acres, or 45.1 percent of the state's 19.51 million acres of forestland (compared with 5.6 million acres and 28.7 percent by pine forest) (Mississippi Forestry Commission, 2017). Of the 8.8 million acres of hardwood forests, approximately 7.4 million acres are classified as upland hardwood forests (NLCD, 2011). Many of the active hardwood management efforts in Mississippi occur in bottomland hardwood forests for various reasons. These reasons are typically related both to historic value of species suitable for these sites and shorter rotation lengths compared to those possible for upland hardwood species and sites. Consequently, much of the information available to forest managers in Mississippi centers on management of bottomland hardwood species with little readily accessible data specific to upland hardwoods. Lack of information, combined with longer upland

hardwood rotations, often result in absence of active management for this stand type. Across Mississippi, these stands exist in various states of manageability with little applied silviculture occurring.

This publication attempts to answer a question often asked by Mississippi upland hardwood owners: "Do I manage or regenerate my stand?" Whether to actively manage a stand at any given time during the rotation depends on several factors. Management potential can range from very low to very high. Stands of very low potential are easy to identify because of overall low desirability of the trees. On the other hand, stands with very high management potential are also easy to identify due to presence of high-quality trees. It is when trees are of medium quality or health that owners face the biggest challenge in deciding whether to manage or regenerate their stands. The following information is designed to aid managers in determining where an upland hardwood stand fits in the overall manage or regenerate decision scale.

Table 1. Desirability of common species for upland hardwood timber production.

Desirable species	Undesirable species
Northern red oak	Blackjack oak
Southern red oak	Post oak
Black oak	Elm species
Shumard oak	Hickory species
White oak	Maple species
Ash species ¹	Blackgum
Yellow poplar	Sweetgum

¹If emerald ash borer becomes established in Mississippi, ash species may not be considered desirable in the future.

Defining Manage and Regenerate

Deciding whether to manage or immediately regenerate an upland hardwood stand is the first step in the evaluation process. This decision is based on whether enough desirable trees are present to merit continued management. Hardwood stands are typically evaluated on 10-year intervals known as cutting cycles. Consequently, the decision to manage means that the stand will be managed for another cutting cycle before being reevaluated. The decision to manage should not be taken lightly as treatments such as improvement thinnings and timber stand improvement can be expensive. While they may increase stand growth, these treatments typically are justifiable only if they result in positive returns on investment at the end of the rotation.

If the decision is to regenerate a stand, it should be regenerated as soon as is feasible. Either natural or artificial regeneration can be used. However, assuming presence of an appropriate seed source, natural regeneration is preferred due to the cost of artificial methods.

Establishing a Management Objective

Management goals or objectives should be determined before stand evaluation. Primary management objectives vary and can include timber production, recreation, wildlife habitat improvement, and aesthetics. Landowners may have one or more objectives that can drive stand evaluation criteria. For example, tree species unsuitable for timber management may be highly valued for other objectives like soft mast production for wildlife. This publication considers stand evaluation from a timber-production perspective, but it is important to consider other goals in evaluations.

Site Quality

Site quality should be the primary underlying factor used in establishing management objectives for upland hardwood stands. Site quality can also be thought of as soil productivity because soil properties influence the ability of a site to grow different tree species and produce quality products. Consideration of site quality tells us which spe-

cies and forest products should be the focus in management efforts. In more mountainous regions, slope aspect warrants consideration when evaluating a stand. Due to the relatively flat terrain found across most of Mississippi, aspect rarely drives site quality in upland hardwood stands.

Stand Evaluation Factors

The decision to manage or regenerate an upland hardwood stand involves multiple factors including species composition, stem quality, tree vigor, and stand age.

Species Composition

Determining desirability of tree species for management may be more complex than you realize. Site productivity limits what species will be desirable for management, and determining which species will maintain market value over time can be very difficult. A species considered high value today will not necessarily be worth that much in the future due to changes in trends and demands. The difference in value of individual species over time complicates management. However, oaks have historically maintained higher values due to use in more expensive wood products.

Growth rate of different species also affects desirability. Many oak species maintain good growth rates, which increases desirability as a manageable species. Some species may have market value at times (hickory, for example), but due to slower growth rates, poor wood quality, and market variability, they are not typically viewed as desirable species for timber production. Table 1 lists a few species by desirability class as examples for timber production. Again, species desirability may be driven by goals other than timber, and managers should remember to consider these when evaluating species.

Stem Quality

Stem quality is an extremely important factor in hardwood stand evaluation. Hardwood quality is evaluated in the butt log of a tree because most of the lumber value is contained in this section. The butt log is the first 17.3 feet of stem with log grade being assigned through a grading

process detailed in Mississippi State University Extension Publication 3179, *Grading Hardwood Trees: A Guide to Identifying Stem Quality in Hardwood Stands*.

Properly grading hardwood logs takes significant expertise and experience. One of three field grades (F1, F2, or F3) is assigned based on factors including diameter, amount of clear wood, and straightness. Diameter is especially important in log grading because larger-diameter trees can grade higher with shorter lengths of wood compared to smaller-diameter trees.

Tree Vigor

Vigor of trees within a forest influences the overall ability of a stand to sustain growth and value. High-vigor trees are better equipped to defend themselves against insects and disease. Subsequently, they are less likely to degrade or suffer decay, resulting in value reduction or death.

Evaluation of tree vigor is somewhat subjective, and accurate assessment relies somewhat on experience of the observer. Typically, three vigor classes are used in stand evaluations (low, medium, and high). Vigor observations are made pertaining to condition of two key elements: tree crown and tree bole (trunk). High-vigor tree crowns should be full and show no signs of limb dieback and/or decay. High-vigor boles should have tight bark and show no evidence of damage or decay. Remember that different tree species will possess different sized crowns and bark characteristics. Therefore, knowledge of different tree species characteristics is important when determining tree vigor.

Stand Age

Stand age is an important consideration when performing hardwood evaluations. While bottomland hardwood stands may be managed for rotations as short as 60 years, upland stands managed for timber production on quality sites are typically managed on 80-year rotations. Stands managed for other purposes, or those on lower-quality sites, may be managed for longer periods of time, but trees within the stand are likely to lose vigor and degrade. These losses can be costly in older hardwood stands.

Stand age can be determined by counting growth rings of felled trees or through use of an increment borer to core standing trees. Make sure to age several trees to obtain an accurate average age for the stand. Although the vast majority of upland hardwood stands are even-aged, there may be a significant range of tree ages within any given stand.

Tree Management Categories

The tree characteristics used to evaluate hardwood stands (species desirability, vigor, grade, and stand age) can be used to categorize trees within a stand. These categories include manageable trees, cull trees, and undesirable trees.

Stand evaluation should focus on determining the number of trees per acre in each category. This categorization is helpful in determining the manageability of a stand.

Manageable Trees

Manageable trees meet conditions allowing for achievement of management goals. If timber production is the primary goal, trees should be of desirable species, medium to high vigor, of sufficient grade, and young enough that continued management through at least one cutting cycle without significant degrading is likely. Ratings may differ for goals other than timber production.

Cull Trees

Cull trees are specimens of desirable species that do not have the proper grade to meet desired objectives. While these trees may not be of commercial value, they may serve in other roles (such as denning trees, mast producers for wildlife, or snags that produce habitat for various animal species). In addition, they may serve as seed sources for natural regeneration in the event that evaluation results in a decision to regenerate.

Undesirable Trees

These trees are of a species undesirable for achievement of management objectives. Management operations should focus on removing them.

Collecting Data for Stand Evaluation

Data collection for hardwood stand evaluation should be performed by someone knowledgeable in upland hardwood species characteristics. A landowner can collect data and perform simplified stand evaluations, but the level of expertise typically requires a consulting forester. Names and addresses of consulting foresters can be found on the Mississippi Board of Registration for Foresters website at <https://www.borf.ms.gov>. For information on how to select a consulting forester, please read Mississippi State University Extension Publication 2718, *Choosing a Consulting Forester*.

Depending on landowner objectives, different levels of management intensity may be appropriate. Consequently, stand evaluation data collection can range from simple to relatively complex. For example, a landowner with a lack of interest in intensive management may only desire to categorize trees based on desirability. However, a landowner with specific and/or multiple management objectives may use all the above-mentioned factors in evaluation of a stand.

Data collection for hardwood evaluations can be gathered using circular, fixed-area plots (0.1-acre or 0.2-acre plots) to sample midstory and overstory trees (Figure 2). The number of data-collection plots necessary varies depending on variation of the stand. For small stands (up to 40 or 50 acres), one plot should

Stand name: Sample		Plot size: 10th acre				Stand age: 45 to 60 years		
						Tree category		
Plot #	Tree #	Species	Diameter	Grade	Vigor	Manageable	Cull	Undesirable
1	1	Desirable	12	3	M	X		
1	2	Undesirable	10					X
1	3	Desirable	18	1	H	X		
1	4	Desirable	8	NA ¹	M	X		
1	5	Desirable	14	2	H	X		
1	6	Desirable	16	X ²	M		X	
1	7	Undesirable	6					X

¹Cannot grade an 8-inch-diameter tree
²This tree did not contain enough clear wood to make grade.

be taken for every 2 acres. For larger stands, sampling could decrease to one plot for every 5 or 10 acres; however, to ensure representative data, no fewer than 25 or 30 plots should be recorded. Tenth-acre plots (37.2-foot radius) are typically used in stands with smaller-diameter trees, and fifth-acre plots (52.7-foot radius) are used in stands with larger-diameter trees. The stand characteristics discussed above, including species desirability, grade, vigor, and stand age, are used to categorize trees into the three tree categories: manageable, cull, or undesirable. Plot data can then be adjusted to per-acre values using appropriate “blowup” factors for each category (multiplying by 10 for tenth-acre plots and five for fifth-acre plots). This information is then used to determine if enough manageable trees exist to continue to manage a stand or if regeneration should be considered.

Table 2 provides a sample data sheet for stand evaluation data collection. Stand age, species class, diameter, grade, and vigor are all recorded. Stand age is the age range of trees within the stand. Species class is entered as desirable or undesirable. Diameter is recorded in inches and will be used to aid in determination of the number of trees per acre (TPA) required for a stand to be considered manageable. Tree grade is recorded for all trees 12 inches and larger. Vigor is recorded as high, medium, or low. Finally, these variables are all used to classify each tree in the plot.

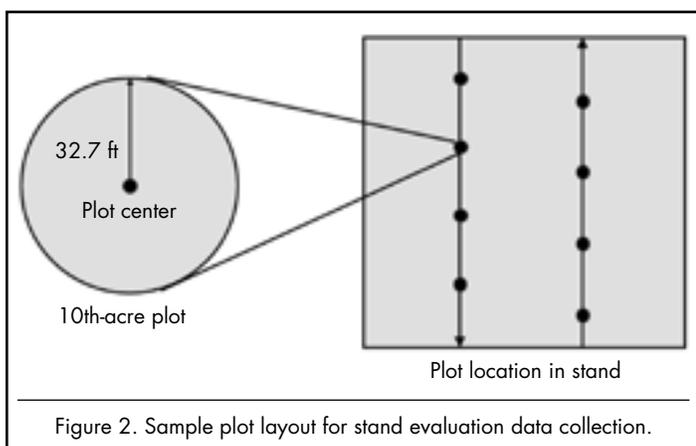
The sample plot in Table 2 includes four manageable trees, one cull, and two undesirable trees. To convert to per-acre values, multiply plot information by 10 (a tenth-acre plot was used in the example). This calculation results in 40 manageable, 10 cull, and 20 undesirable TPA. Remember, data should be collected for several plots and plot averages calculated before converting to per-acre values.

Recording Regeneration Information

If there is any possibility that stand evaluation will result in the stand being regenerated, collecting data on the presence of already established regeneration may be prudent. Regeneration plots are easy to take and can be recorded while collecting data for midstory and overstory evaluation purposes. Evaluation of regeneration in hardwood stands is usually performed using 100th-acre (11.8-foot radius) circular plots. Seedlings should be tallied in the sample area by size class (less than 1 foot, 1–3 feet, and greater than 3 feet in height) and converted to per-acre values after collecting data from several plots. One regeneration plot should be taken for every 2 acres in smaller stands. Assuming adequate distribution of regeneration sampling, the ratio of plots per acres can increase in larger stands, but regeneration data should still be recorded on at least 25 to 30 plots across the stand. Regeneration data may be useful in determining proper procedures should the decision be made to utilize natural regeneration.

Using Evaluation Data

While varying management objectives limit establishment of a universal minimal TPA target at which a stand is considered manageable, size of trees in the stand will play an integral role in deciding this number. Upland hardwood stands with diameters in the smaller 8- to 12-inch range will require a greater number of manageable trees than a stand with trees in the 16- to 20-inch range. There is an accepted rule of thumb regarding range of minimal TPA needed for a stand to be manageable. Typically, this minimal range is between 50 and 70 TPA.



Stocking Tables

Stocking tables are very useful in making management decisions regarding upland hardwood stands. These tables provide managers with an idea of the TPA required for stands of different average diameters at different stocking levels. Stocking tables are based on the number and diameter of trees present; however, knowing manageable TPA numbers allows the use of these tables to aid in performing stand evaluations.

Table 3 gives the TPA required for upland hardwood stands to be understocked, stocked, or overstocked at various aver-

age diameters. For example, if a stand has an average diameter of 10 inches, 95 TPA is required for the stand to be considered understocked, 125 TPA for it to be fully stocked, and 215 TPA to reach overstocked status. Understocked numbers represent minimum TPA required for a stand to be considered manageable (40 percent stocking). For a timber production objective, a stand needs to reach at least an understocked status to be considered manageable. Knowing manageable TPA makes this information very useful in determining whether a stand is manageable or should be regenerated.

Table 3. Minimum stocking levels for upland hardwood stands to be understocked, fully stocked, or overstocked.

Stocking level	Average diameter	Trees per acre	Basal area ¹	Stocking percent
Understocked ²	8	130	46	40
	10	95	52	40
	14	58	62	40
Fully stocked	8	177	62	60
	10	125	68	60
	14	70	75	60
Overstocked	8	305	106	100
	10	215	117	100
	14	118	126	100

Adapted from Gingrich 1967.

¹Basal area is a measure of stand density used to assess the cross-sectional amount of wood on an acre in feet squared. Higher basal area values indicate more wood on a given acre.

²Understocked numbers indicate the minimum number of trees needed for a stand to be considered manageable.

Main Points

- Management objectives/ goals should be determined before starting a stand evaluation.
- Primary tree attributes used in stand evaluations include species desirability, tree size, tree vigor, and stand age.
- Tree attributes are used to categorize trees into one of three categories: (1) manageable trees, (2) cull trees, and (3) undesirable trees.
- Different intensities of data collection can be used to categorize trees into management categories depending on the intensity level of desired management.
 - If less intensive management is desired, species desirability may be the only information needed to categorize trees.
 - If more intensive management is desired, all tree attributes may be needed for adequate evaluation of stands.
- Sample plots should be used to collect tree data, and plot data should be converted to per-acre averages to obtain the number of manageable, cull, and undesirable trees per acre.
- Stocking tables can be useful in stand evaluations.
 - A stocking level of at least 40 percent is needed for an upland hardwood stand to be considered understocked. Stands possessing this minimal number of stems contain enough material to grow into a fully stocked level in the future.
 - Ideally, a stand should be at the fully stocked level for maximum production of wood.
 - Thinning operations should be considered in hardwood stands nearing or at the overstocked level if maintenance of quality and tree growth is desired.

Upland hardwood stand evaluation is essential in determining whether continued management or regeneration of a stand is warranted based on the goals of ownership. Evaluating these stands often yields an idea of current stand condition and establishes baseline data for making management decisions and scheduling future silvicultural activities to achieve management goals.

Additional Reading

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