Bottomland Hardwoods: 
Match the Species to the Site

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As the price paid for hardwood stumpage goes up, so does interest in hardwood management among southern landowners. Unfortunately most landowners and even some forest managers do not fully understand the basic requirements for good hardwood growth and survival.

Pines are relatively "elastic" in their site requirements and are adaptable to a very wide variety of site conditions. They can survive and prosper on sandy sites with good to excessive drainage, and they can also grow well on some poorly drained sites.

Most desirable species of hardwoods, however, have more demanding site requirements and will only survive and grow well on a comparatively narrow range of sites. Furthermore, stem grade or quality is a major consideration for hardwoods and may be greatly influenced by site conditions.

Bottomland Hardwood Sites
All forested sites in the South can be divided into three physiographic site positions — uplands, terraces and floodplains. Uplands occupy by far the greatest land area in the South. Soils on these areas were formed in place from the parent geologic material or in some cases from wind-blown materials. Terraces are old floodplains of current or ancient stream systems. Soils are alluvial in origin and generally are not as productive for hardwoods as the current floodplain soils. Because of their older age, nutrients have been leached and many terrace soils have fragipans.

The term "bottomland hardwoods" generally refers to hardwoods associated with current floodplain sites. Soils on
these sites are from recent alluvium, relatively young, generally have good water relations and may be highly productive for hardwood growth and survival. Floodplain sites in the South are somewhat arbitrarily divided into major and minor bottomlands. The difference between the two is obvious based on the size of the stream — major bottoms are usually associated with large rivers. The alluvium deposited in major river bottoms may come from hundreds or even thousands of miles away and is composed of materials of all textural classes and perhaps several kinds of minerals. In minor bottoms, the alluvial deposits are of local origin and may vary less in textural class and mineralogy. For this reason, major bottoms are most often, although not always, more productive than minor bottoms.

Bottomland hardwoods occur primarily in the Atlantic and Gulf Coastal Plain Divisions of the Coastal Plain Province. There are currently about 30 million acres of bottomland hardwoods in the South. This area is less than one-half the area present at the time of European settlement. Most of the reduction is a result of conversion to agricultural uses and much of the loss has been in the Mississippi River system.

**Bottomland Topography**

Site variation within floodplains is associated primarily with elevational differences. Differences in elevation of only 2 or 3 feet have a marked effect on site and therefore on species occurrence. These differences reflect primarily differences in drainage and soil moisture, but minor elevation differences also reflect differences in soil type, texture, structure and pH, all of which affect species occurrence. Topographic, and therefore site, variation within a floodplain and subsequent deposition patterns is the result of stream movement within the floodplain and subsequent deposition patterns.

Figure 1 shows a cross section of a hypothetical major stream valley on the coastal plain. Each topographic feature shown may occur several times and not necessarily in the order shown.

Bars or point bars are formed when the concave section of stream banks erode and the sediment is deposited downstream on an opposite convex area of the stream channel. With time and increased deposition, the bar may become a mud flat and may eventually be raised to the level of the current front or natural levee.

Fronts, generally represent the best sites for tree growth in the floodplain. These natural levees are formed when streams overflow their banks and rapid deposition occurs. These areas are typically the highest sites with the best surface and internal drainage. They are the most productive areas, and virtually all desirable bottomland hardwood species can be grown on these sites.

Ridges are nothing more than old fronts and are generally considered to be the second best sites for hardwoods. These areas vary in elevation from 2 to 15 feet above flats, but 2 to 3 feet is much more common. Drainage class is not as good as on fronts, and since the soils are older, fertility may be lower than fronts. By comparison, soils in ridges are more coarse-textured than those in flats and drainage is therefore better. Species suitability on these sites would be limited primarily by the typical absence of pioneer species such as yellow poplar.

Flats represent a significant change in site quality as compared to fronts and ridges. These are typically broad, smooth areas between ridges or between ridges and fronts. The soils are predominantly clays and the drainage class usually varies from poorly drained to somewhat poorly drained, but standing water is usually absent most of the growing season. There may be slight elevational differences and variations classified as "high flats" and "low flats" can often be recognized based on drainage patterns. Flats account for the largest area within the floodplain, and overall, the number of desirable species and growth on these sites will be less than on fronts and ridges.

Sloughs are shallow depressions originating from old stream channels which are almost filled with sediment. These low areas with very poor drainage, heavy clay soils and standing surface water is typically present well into the growing season. These sites generally support the growth of lower quality and less desirable species such as overcup oak and water hickory.

Swamps are also old stream channels, but the channel is deeper and surface water is typically present year round. Species suitability in these areas is extremely restricted by the water, with baldcypress and water tupelo being representative.

**Species/Site Relationships**

While a large number of hardwood species occur on floodplain sites, only a comparitve few are generally regarded as desirable for timber production. A summary of species suitability by site classification is found in Table 1. The table is not intended as a complete listing of all species, but the species listed are considered to be most appropriate for these site types.

There are other wet sites which support hardwood growth but are not associated with stream floodplains. These sites are typically covered with hardwoods because they are not suitable for growth and development of pines. Generally, these sites are not as productive as floodplains and the hardwoods are of lower quality. Examples of these sites are coastal swamps and muck swamps. They may support a variety of hardwoods, but baldcypress and tupelos are typical.

In major stream bottoms, species associations will vary depending on the stage of succession. Even though not all the species are desirable, a review of the more common combinations is presented. This listing of species presence with reference to natural patterns gives insight to the need for active management of these areas if the most desirable species are to be grown and maintained.

*Bars.* On bars, willow is the major

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Figure 1. Cross-section of stream valley showing minor topographic positions within the floodplain.
pioneer species, but if the land is high enough or if it can become established between high water levels, cottonwood will come in. Willow and cottonwood need mineral soil to become established, but willow is more tolerant of water. Both species can withstand sediment deposition, and if it continues, front land will be formed and willow and cottonwood may be replaced by river front species.

**Fronts**. On fronts, a typical association following cottonwood is composed of elm, sycamore, sweet pecan, sugarberry, boxelder and sweetgum. This river front association is not climax and the successional association will depend on how the stand is replaced. If replacement is rapid (man caused or natural disaster), a red oak-sweetgum type may occur if advance regeneration is present. If replacement is slow, the stand will retrogress to a boxelder-sugarberry or boxelder-hackberry-silver maple association. As the site matures, it may again be occupied by an association composed primarily of sweetgum and red oaks.

**Flats**. Species composition on the flats is extremely variable. On low flats, overcup oak, water hickory and cypress often predominate. Almost pure stands of overcup are common. On high flats, the most common association is composed primarily of elm-sugarberry with other species such as Nuttall oak, willow oak, and red maple being common in the mixture. Nuttall oak and willow oak will on occasion be major components of the stands.

**Ridges**. On ridges, species composition depends largely on past events and past treatments. The elm-sugarberry type is the most common association, but if the site is opened rapidly and advance regeneration is present, it can be replaced by a sweetgum-red oak type composed of water oak, willow oak, cherrybark oak. Shamard oak and other minor species in addition to sweetgum. Without management, this type will revert back to the elm-sugarberry association through natural succession.

**Sloughs**. If sloughs are near the stream and/or sedimentation occurs rapidly, good stands of black willow often occupy the site. If sedimentation continues, the willow will be replaced by the elm-sugarberry type. On sites where sedimentation occurs slowly, t.g., at some distance from the stream, overcup oak, water hickory, green ash and persimmon are the tree species which most often follow the willow.

**Swamps**. The baldcypress-water tupelo type is most common in the swamps of major river bottoms. Depending on depth and duration of flooding, other tree species which sometimes occur include swamp tupelo, water elm, Carolina ash, water hickory, swamp laurel oak and overcup oak.

### Table 1. Site suitability for bottomland hardwoods.

<table>
<thead>
<tr>
<th>Site position</th>
<th>Desirable/Suitable Species</th>
<th>Minor Bottoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bars</td>
<td>Cottonwood</td>
<td>River birch, willow</td>
</tr>
<tr>
<td>Fronts</td>
<td>Cottonwood, water oak, sweetgum, sycamore, pecan, green ash (cherrybark oak, swamp chestnut oak)</td>
<td>Cherrybark oak, Shamard oak, sweetgum, sycamore, yellow poplar</td>
</tr>
<tr>
<td>Ridges</td>
<td>Water oak, willow oak, sweetgum, green ash, (cherrybark oak, swamp chestnut oak)</td>
<td>Cherrybark oak, Shamard oak, swamp chestnut oak</td>
</tr>
<tr>
<td>High Flats</td>
<td>Nuttall oak, green ash, willow oak, sugarberry</td>
<td>Cherrybark oak, Shamard oak, water oak, willow oak, swamp chestnut oak</td>
</tr>
<tr>
<td>Low Flats</td>
<td>Overcup oak, water hickory, green ash, persimmon, sugarberry</td>
<td>Willow oak, overcup oak, green ash, persimmon</td>
</tr>
<tr>
<td>Sloughs</td>
<td>Overcup oak, water hickory, black willow</td>
<td>Overcup oak, persimmon</td>
</tr>
<tr>
<td>Swamps</td>
<td>Baldcypress, water tupelo</td>
<td>Baldcypress, water tupelo, swamp tupelo</td>
</tr>
</tbody>
</table>

1 Species in parenthesis may not be found on those sites in the Mississippi River floodplain.

### Minor Stream Bottoms

Minor stream bottoms are in many ways simply a smaller version of major bottoms – they exhibit the same topographic features and most of the same species occur there, although not necessarily on the same topographic position. Species which occur only on ridge positions in major bottoms often occur on flats in the minor bottoms. River birch is most often the pioneer species on new land such as bars and mud flats. Species composition is extremely diverse on the fronts or natural levees and may include yellow-poplar. American beech, sycamore, spruce pine, sweetgum, cherrybark oak. Shamard oak, water oak, swamp chestnut oak, and several species of hickory. Although flooding still occurs, autogenic forces control natural succession and species occurrence on these front sites.

Typical species occurring on better drained flats and ridges of minor bottoms include sweetgum, cherrybark oak, water oak, swamp chestnut oak. American elm and hickories. On less well drained flats the major species include overcup oak, Nuttall oak, swamp laurel oak, persimmon, green ash, sugarberry and red maple.

Species composition occurring in sloughs of minor bottoms will vary depending on duration of flooding. Cypress, swamp tupelo, and water elm are common where flooding duration is longest, and overcup oak, water hickory and persimmon will occur where flooding is not as severe. Swamps containing cypress and water tupelo do occur on the floodplains of minor bottoms, but the cypress and swamp tupelo type is more common.

### Implications for Use or Management

Matching a hardwood species to the site(s) to be managed or regenerated requires substantial “homework” in most situations. Review of soil maps, topographic maps and on-site visits all aid the land manager in determining which hardwood species to favor in a given area.

In addition, a knowledge of species-site relationships is essential for successful management of bottomland hardwood stands, whether the objective is timber, wildlife or a combination of the two. For example, reforestation or restoration projects are likely to be a complete failure if the species are not matched to the site.

It is important to note that bottomland ecosystems are not static. The biotic and abiotic components will change over time with or without the influence of man. What is there today will not be there 100 years from now, or perhaps even 10 or 20 years from now. For example, black willow stands simply do not live very long. They will be replaced, and new ones will not be created except by disturbance – natural or man-made.

The ecological processes and species/site relationships discussed in this article have implications for making management decisions which could resolve or reduce conflicts over use of the bottomland hardwood resource. These areas are very diverse and thus, over large areas, a great variety of uses and interests can be accommodated. Active management can be used to maintain or increase compositional and structural diversity to meet the objectives of ownership.