Bottomland Hardwood Management

Species/Site Relationships

Some of the most demanding tasks of managing forestlands involve the management and regeneration of desirable trees on different sites. This is true for all trees but is especially true for hardwoods. Most landowners and even some forest managers do not fully understand the requirements for good hardwood growth and survival.

Pines are relatively elastic in their site requirements and are adaptable to a variety of site conditions. Pines can survive and prosper on sandy sites with good drainage, and they can also grow on poorly drained sites. But, the best hardwoods have more demanding site requirements and will survive and grow well only on a narrow range of sites.

Bottomland Hardwood Sites

All forested sites in the South can be divided into different types of physical geography: uplands, terraces, and floodplains. Uplands make up the greatest land area in the South. Soils in these areas were formed from the earth's crust or from wind-blown materials. Terraces are old floodplains of current or ancient streams. Although the soils are rich in alluvium, the hardwoods grow better in floodplain soils. Older terrace soils have lost their nutrients over time, and many have layers of hard, unbroken ground.

The term "bottomland hardwoods" refers to hardwoods found in current floodplain sites. Soils on these sites are young, have good drainage, and may be highly productive for hardwoods.

Floodplain sites in the South are divided into major and minor bottomlands. This difference may be obvious in the size of the stream, since major river bottoms are usually associated with large rivers. However, another important difference may be in the nature of the deposits. The alluvium deposited in major river bottoms may come from hundreds or even thousands of miles away and be composed of materials of all textural classes and several kinds of minerals. In minor bottoms, the alluvial deposits are of local origin and may vary less in texture and minerals. For these reasons, major river bottoms are often more productive than minor bottoms.

Bottomland hardwoods mainly occur in the Atlantic and Gulf Coastal Plain divisions of the Coastal Plain Province. There are about 30 million acres of bottomland hardwoods in the South. Their occurrences are determined by the nature of the soils that are sedimentary in origin and easily eroded, unlike the more solid soils of the mountain and piedmont regions. Long ago, when the climate was much warmer and wetter, ancient streams eroded away material to form stream valleys. The streams continue to deposit rich sediments.

Site Variations

Site variation within floodplains is mainly associated with elevation differences, with as little as two to three feet having a marked effect on site and species occurrence. These differences in elevation reflect in changes in drainage and soil moisture, but minor elevation variations also reflect contrasts in soil type, texture, structure, and pH. All of these factors affect what type of trees will grow on the site. Changes in elevation within a floodplain affect deposit patterns as the stream moves within the floodplain.

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Figure 1 depicts a cross section of a major stream valley of the coastal plain. Each topographic feature shown may occur several times and not in the order shown. There is a notable difference between bottomlands found in the Atlantic Coastal and Gulf Coastal Plain in that ridge, and swamps are far more common in the Atlantic Coastal regions. This variation is due to differences in the formation of the floodplains.

Fronts represent the best sites for tree growth in the floodplain. These natural levees form when streams overflow their banks and rapidly deposit sediment. These areas are usually the highest sites with the best drainage. Virtually all hardwood species can grow on these sites.

Bars are formed when the concave section of a stream bank erodes and the sediment is deposited downstream on an opposite convex area of the stream. With time and increasing deposits, the bar may become a mud flat and may eventually be raised to the level of the current front.

Ridges are old fronts and are considered to be the second best sites for hardwoods. These areas vary in elevation from two to fifteen feet above flats, but two- to three-foot elevations are more common. Drainage may not be quite as good as on fronts, and soil fertility may be lower. Soils in ridges are coarser than those in flats, and drainage is better. Tree growth on these sites is limited by the absence of pioneer species such as yellow poplar.

Flats represent a significant change in the site quality when compared to fronts and ridges. Flats are broad, smooth areas between ridges or between ridges and fronts. The soils are mostly clays, and the drainage varies from poor to somewhat poor, although standing water is usually absent during most of the growing season. There may be slight elevation differences. Variations classified as "high flats" and "low flats" are based on drainage patterns. Flats account for the largest area within the floodplain. Overall, the number of desirable trees that will grow on these sites is less than on fronts and ridges.

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

Swamps are also old stream channels, but the channel is deeper and surface water is usually present year-round. Certain species' ability to grow in these areas is restricted by the water, but baldcypress and water tupelo tend to thrive.

Species Occurrence

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

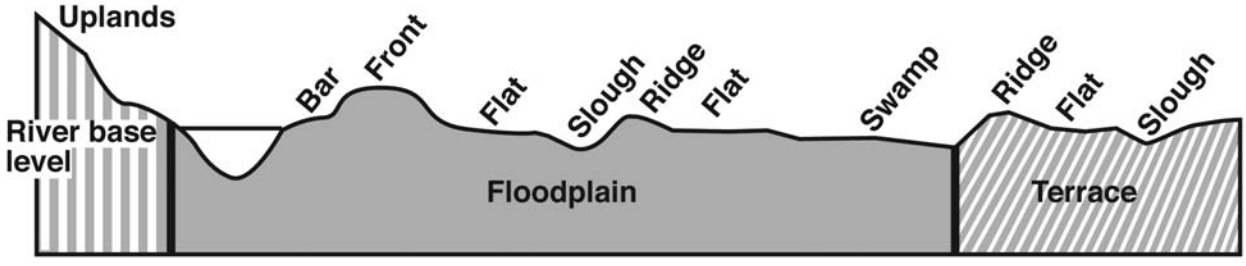
There are other wet sites that support hardwood growth but are not associated with stream floodplains. Sites such as coastal swamps and muck swamps are usually covered with hardwoods because they are not suitable for growth and development of pines. Generally, these sites are not as productive as floodplains. The hardwoods growing there, usually baldcypress and water tupelo, are of lower quality.

In major stream bottoms, the types of trees will vary, depending on the stage of the floodplain. Even though not all the species are desirable, a list of the more common combinations follows. This listing refers to natural patterns and gives insight to the need for active management of these areas if the most desirable trees are to be grown and maintained.

On **bars**, willow is the major pioneer species, but if the land is high enough or becomes established between high water levels, cottonwood will grow. Willow is more tolerant of water. Both species can withstand sediment deposits, but if it continues, a front may form. If this happens, willow and cottonwood may be replaced by riverfront species.

On **fronts**, a typical group of trees is composed of elm, sycamore, sweet pecan, sugarberry, boxelder, and sweetgum. This riverfront stand is not final, and its succession depends on how it is replaced. If replacement is rapid (caused by humans or natural disaster),

Figure 1. Cross section of stream valley showing minor topographic positions within the floodplain.



a red oak and sweetgum stand may grow. If replacement is slow, the stand will be home to a boxelder and sugarberry or boxelder, hackberry, and silver maple mix. As the site matures, it may again be occupied by sweetgum and red oak.

The types of trees growing on **flats** are variable. On **low flats**, overcup oak, water hickory, and cypress dominate. Almost pure stands of overcup oak are common. On **high flats**, the most common group is elm, ash, and sugarberry, with other species, such as Nuttall oak, willow oak, and red maple being common in the mixture. Nuttall oak and willow oak on occasion will be predominant in a stand.

On **ridges**, past events and treatments affect the species that will grow. A combination of elm, ash, and sugarberry is the most common, but if the site is opened rapidly and regeneration is present, it can be replaced by a stand composed of sweetgum, red oak, water oak, willow oak, cherrybark oak, Shumard oak, and other minor species. Without management, these stands will revert back to an elm, ash, and sugarberry mix.

If **sloughs** are near the stream, and/or sedimentation occurs rapidly, good stands of black willow will occupy the site. If sedimentation continues, the willow will be replaced by elm, ash, and sugarberry. On sites where sediments are deposited slowly at some distance from the stream, overcup oak, water hickory, green ash, and persimmon will grow in after the willow.

Baldcypress and water tupelo are the most common species in the swamps of major river bottoms. Depending on depth and duration of flooding, other tree species that sometimes grow include swamp tupelo, water elm, Carolina ash, water hickory, swamp laurel oak, and overcup oak.

Minor stream bottoms are just a smaller version of major river bottoms. They exhibit the same physical features, and most of the same species live there. Species that 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. Many different types of trees grow on the fronts and may include yellow poplar, American beech, sycamore, spruce pines, sweetgum, cherrybark oak, Shumard oak, water oak, swamp chestnut oak, and several species of hickory.

Although flooding still occurs, natural forces control the succession and species on these sites. Typical species growing on the well-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, willow oak, Nuttall oak, swamp laurel oak, persimmon, green ash, sugarberry, and red maple. Tree species growing in sloughs of minor bottoms will vary depending on the duration of flooding. Cypress, swamp tupelo, water tupelo, and water elm are common where flooding lasts a long time, and overcup oak, water hickory, and persimmon will also occur where flooding is not as severe.

Implications for Use or Management

Matching a hardwood species to the site(s) to be managed requires much research. Soil and topographic maps and site visits will help you determine which hardwood species to favor in a given area.

Knowledge of species/site relationships is needed to manage bottomland hardwood stands, whether you want timber, wildlife, or a combination of the two. Reforestation projects are likely to fail if the species are not matched to the sites.

It is important to note that bottomland ecosystems are not static. With or without human interference, what is there today will not be there 100 years from now or even ten or twenty years from now.

The ecological processes and species/site relationships discussed in this publication can help you make management decisions that could resolve or reduce conflicts over the use of bottomland hardwood resources. These areas are diverse and can accommodate a great variety of interests and uses. You can use active management to maintain or increase the diversity of your tree stands to meet the objectives of ownership.

Table 1. Site Suitability for bottomland hardwoods

Topographic site position	Desirable/suitable species	
	Major bottoms	**Minor Bottoms**
Bars	Cottonwood, willow	River birch, willow
Fronts	Cottonwood, water oak, sweetgum Sycamore, pecan, green ash (cherrybark oak, swamp chestnut oak)[1]	Cherrybark oak, Shumard oak, sweetgum, sycamore, yellow poplar
Ridges	Water oak, willow oak, sweetgum, green ash (cherrybark oak, swamp chestnut oak)[1]	Cherrybark oak, Shumard oak, swamp chestnut oak
High flats	Nuttall oak, green ash, willow oak Sugarberry	Cherrybark oak, Shumard oak, water oak, willow oak, swamp chestnut oak
Low flats	Overcup oak, water hickory, green Ash, persimmon, sugarberry	Willow oak, overcup oak, green ash, persimmon
Sloughs	Overcup oak, water hickory, black willow hickory, black willow	Overcup oak, persimmon
Swamps	Baldcypress, water tupelo	Baldcypress, water tupelo, swamp tupelo

[1]Species in parentheses may not be found on those sites in the Mississippi River floodplain.

Literature Cited

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