Bottomland hardwood reforestation for Neotropical migratory birds: Are we missing the forest for the trees?

Daniel J. Twedt and Jeff Portwood

Throughout the southeastern United States, forested wetlands that were drained and cleared for agriculture are being reforested through individual, corporate, and government efforts (Haynes et al. 1988, Haynes et al. 1995). Within the Mississippi Alluvial Valley, reforestation efforts on former bottomland hardwood sites (Savage et al. 1989, Newling 1990) are bolstered by U.S. Army Corps of Engineers mitigation, acquisition of public lands for wildlife management, and government incentives to private landowners, such as the Wetland Reserve Program. Reforestation provides myriad environmental benefits including flood control, decreased soil erosion, improved air and water quality, and reduced pesticide use.

Wildlife managers and foresters, however, have historically sought to increase the area of bottomland hardwood forest because of its value as wildlife habitat and for timber production. More often than not, oaks (*Quercus* spp.) are considered the species of choice for reforestation. Oaks are important to game species such as white-tailed deer (*Odocoileus virginianus*) and turkey (*Meleagris gallopavo*). In terms of providing forage for waterfowl, the value of bottomland hardwood forests is directly related to the proportion and species composition of oaks within the forest (Allen 1987). Valuable lumber is also derived from harvested oaks. Therefore, to maximize profits at harvest, a high proportion of mature oaks in the forest is generally desirable.

The benefit of oak forests to Neotropical migratory birds, however, is poorly understood (Martin 1989). But for many insectivorous, forest-breeding birds, the 3-dimensional structure of a forest may be as or more critical than the tree species present. Thus, reforestation to promote rapid development of 3-dimensional forest structure is critical to providing habitat for forest-breeding, Neotropical migratory birds.

In this paper, we identify benefits derived by land managers and wildlife resources when fast-growing trees, such as cottonwood (*Populus deltoides*) or sycamore (*Plantanus occidentalis*), either homogeneously or mixed with oaks, are established on lands under cultivation. In particular, reforestation with fast-growing species promotes rapid colonization of sites by forest-breeding Neotropical migratory birds. We also suggest silvicultural practices that promote succession from fast-growing species to forests dominated by heavy-seeded, slow-growing species.

Silviculture and growth rates

Oaks

Because oaks propagate by comparatively heavy-seeded acorns, seed dispersal by natural mechanisms often is slow and unreliable, particularly on large tracts without adjacent seed sources (Allen 1990). Various reforestation methods have been developed to promote oak regeneration (Allen and Kennedy 1989, Newling 1990, Sharitz 1992). When reforesting tracts previously under cultivation, land managers often plant seedlings or acorns. Planting of seedlings provides an early start to oak regeneration, but seedling stock and labor are expensive. Direct seeding of acorns, via mechanical planters, is less costly than

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planting seedlings (Bullard et al. 1991). Sprouted acorns can achieve growth rates similar to planted seedlings by the time they are saplings, but growth may be impaired by soil type and weeds (Allen 1990).

One concern regarding monotypic oak plantings is the slow growth rate of oaks. From time of planting, 5–10 years may be required before oaks develop a substantial 3-dimensional structure at about 4 m in height. Furthermore, stands of planted oaks may require >20 years to reach canopy closure, even when faster-growing species have naturally seeded within the stand.

Early successional species

When fast-growing species are planted, stands develop substantial 3-dimensional structures in 2–3 years and canopy closure in <10 years. Cottonwood and willow (*Salix nigra*) are fast-growing, early-successional species that pioneer newly formed land in river floodplains (Maisenhelder and Heavrin 1957). Maisenhelder and Heavrin (1957) describe willow and cottonwood silviculture and report 75–90% survival of seedlings and average heights of 1.5 m with growth to 3 m after only 1 year. Strauss and Wright (1991), Turnhollow (1994), and Wright (1994) also provide information on the silviculture and economics of *Populus* spp. Mechanisms for planting other relatively fast-growing species, such as sycamore, green ash (*Fraxinus pennsylvanica*), and sweetgum (*Liquidambar styraciflua*), have also been developed and offer potential for bottomland hardwood reforestation (Waldrop et al. 1983, Ranney et al. 1985, DeBell and Harrington 1993).

Many fast-growing species can be grown from cuttings (Briscoe 1963, Phillips and Netzer 1981, Brown and Sommer 1982). Cuttings are readily available and generally cost less than seedlings. Improved genetic clones also have been developed for some fast-growing tree species (Mohn et al. 1970, Land 1982, Stettler et al. 1992) and offer increased growth rates, improved wood quality, disease resistance, and increased tolerance to extreme environmental conditions. Conversely, improved genetic rootstocks are not generally available for oak species. Finally, if harvested under appropriate environmental conditions, some fast-growing species, such as cottonwood, sycamore, and sweetgum, will coppice (i.e., sprout from existing rootstock), thereby providing a second harvest without replanting (Steinbeck 1978, Hall and Wray 1983).

Comparative growth rate

Early-successional species usually have higher growth rates than heavy-seeded species such as oaks. Cottonwood seedlings planted in Mississippi, had average diameters of 10 cm and mean heights of 7.9 m after 5 years whereas Nuttall oak (*Quercus nuttallii*) averaged 2.5 cm in diameter with mean height of 2.6 m (Krinard and Kennedy 1981). Sycamore seedlings planted on Louisiana soybean fields averaged 4.2 m in height at age 5 with 92% survival whereas cherrybark oak (*Quercus pagoda*) seedlings averaged <2 m tall with 74% survival (Toliver 1986). In South Carolina, Stubbs (1963) found that after 5 years 91% of sweetgum seedlings survived with a mean height of 3.8 m whereas only 72% of Shumard oak (*Quercus shumardii*) survived and averaged 1.6 m in height. Fifteen growing seasons after planting seedlings and controlling weeds by discing, Krinard and Kennedy (1987) found that mean heights were 18.6 m for cottonwood, 11.6 m for sycamore, 11.3 m for green ash, and 9.4 m for sweetgum, but only 6.2 for Nuttall oak. Because of their fast growth rates, less time is required for fast-growing species to meet many economic and ecological goals.

Limitations of alternative species

In all reforestation efforts, site limitations dictate which tree species can be planted (Neebie and Boyce 1959, Broadfoot 1960*a*, Baker and Broadfoot 1979). Soil type limits survival (Broadfoot 1976) and growth (Broadfoot 1960*b*). Similarly, hydrology influences the species suitable for reforestation. For example, planting of wet sites may be limited to flood-tolerant species, such as baldcypress (*Taxodium distichum*), or to moderately flood-tolerant species, such as water hickory (*Carya aquatica*). Compatibility of tree species with site characteristics must be considered in reforestation with early-successional species or with oaks.

If reforestation is intended to provide an economic return, land managers must research potential markets before planting. In particular, if pulpwood harvests are anticipated, landowners must determine if there are buyers for pulpwood or other products, such as biofuel for energy production (Turhollow 1994, Hohenstein and Wright 1994). It would be foolhardy to expect an economic return from tree species for which there is no evident market.

Weed and pest control may be required to culture fast-growing species. Extensive new growth on fast-growing tree species provides succulent forage for browsers, and intense deer browsing can limit growth rates or devastate young tree plantings (Netzer 1984, Clatterbuck et al. 1987). Thus, active deer management may be an integral part of achieving reforestation goals. Weed control is beneficial to the growth of most tree species (Carter 1964, Byrnes and Murray 1968) but may be essential to the survival of fast-growing tree plantings (Waldrop et al. 1983, Hansen et al. 1984, Kennedy 1984). Depending on soil type, lack of weed control after planting may result in failure. Thus, for the first 1 or 2 years after planting, an economic investment in weed control may be necessary. When equipment and personnel for weed control are limited, planting through plastic films or fiber mats (Van Sambeek et al. 1995) may be an effective alternative.

Proposed management for mixed stands

We propose that oaks and other slow-growing species such as pecans (*Carya illinoensis*), can be successfully introduced in concert with or subsequent to planting early-successional species, and that this strategy offers ecological and economic benefits. When oaks and early-successional species are concurrently planted, each type should be planted in alternating rows or blocks to facilitate logging operations if subsequent harvest of fast-growing species is desired. Clatterbuck et al. (1987) found that tree spacing was the key to successfully mixing plantings of oak and sycamore. Adequate light must reach seedlings of shade intolerant species in combined plantings. If shading becomes detrimental, early-successional species may be harvested to release oaks from the shade of faster growing trees.

Alternatively, oaks may be planted following a partial harvest of early-successional species for pulpwood. Partial harvests allow light to reach the forest floor. When the remaining fast-growing species begin to dominate the canopy, they can be harvested for sawtimber to enhance development of oak saplings or left as an integral part of the mature forest.

A variation of this reforestation regime has been implemented by Tri-County Hunting Club and Crown Vantage in Issaquena County, Mississippi. The design provides for 2 harvests of cottonwood, after which 18-year-old oaks remain. Cottonwood cuttings are planted on a 3.7 x 3.7-m spacing with cultivation to control weeds for the first 2 years (Fig. 1). After the second year, oaks are planted on a 3.7 x 7.3-m spacing. The first complete harvest of pulpwood occurs 10 years after planting between October and February. Harvesting during this period maximizes regeneration through coppicing. The second pulpwood harvest takes place 20 years after planting, and 10 years after the first complete pulpwood harvest; this harvest may be either a complete or partial harvest. During harvest, cottonwoods are felled and skidded in rows where oaks are not planted, to avoid damaging oak saplings. After the second pulpwood harvest, the 18-year-old oaks and other naturally seeded species should be large enough to dominate the reforested tract.

Benefits of reforestation with early-successional trees

In addition to the previously identified benefits achieved through reforestation, planting early-successional species can (1) promote rapid colonization by migrant birds, (2) enhance plant species diversity, (3) provide a more rapid financial return to landowners, and (4) enhance the public's perception of reforestation efforts. The rapidly developed vertical structure established by fast-growing trees allows several species of Neotropical migratory birds typically found in forest-shrub habitats to breed and forage in cottonwood plantings. Thirty-six avian species held breeding territories in cottonwood plantings aged 5-7 years (n = 12) including yellow billed cuckoo (*Coccyzus americanus*; 2.4 territories/40 ha), Acadian flycatcher (*Empidonax virescens*; 3.3 territories/40 ha), yellow-breasted chat (*Icteria virens*; 28.8 territories/40 ha), warbling vireo (*Vireo gilvus*; 5.1 territories/40 ha), indigo bunting (*Passerina cyanea*; 28.3 territories/40 ha), orchard oriole (*Icterus spurius*; 10.1 territories/40 ha), and Baltimore oriole (*Icterus galbula*; 12.0 territories/40 ha; Tomlinson 1977, Twedt et al. In Press). Conversely, on oak plantings aged 4-6 years (n = 3), only 9 bird species held breeding territories and most were grassland species such as dickcissel (*Spiza americanus*; 30.1 territories/40 ha), red-winged blackbird (*Agelaius

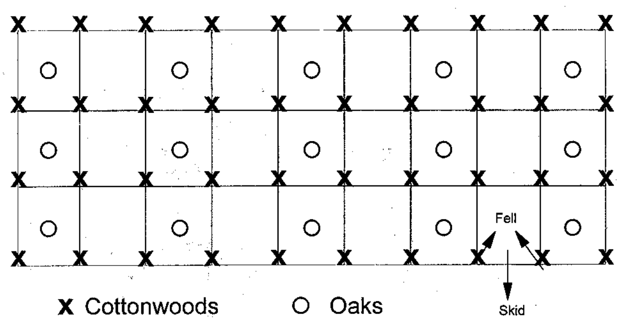

Fig. 1. A planting design combining cottonwoods planted on a 3.7 x 3.7-m spacing with oaks interplanted on a 3.7 x 7.3-m spacing 2 years later. Cottonwoods are harvested twice, at 10-year intervals, leaving 18-year-old oaks after cottonwood harvest.

phoenicus; 30.6 territories/40 ha), and eastern meadowlark (*Strunella magna*; 4.4 territories/40 ha; D. J. Twedt, U.S. Geol. Surv., unpubl. data). Similar species have been found in other oak plantings, with forest-shrub birds found only where fast-growing tree species have invaded (L. W. Burger, Mississippi State Univ., pers. commun.). Thus, fast-growing species act as catalysts for the colonization of these emerging forests by Neotropical migratory birds. Also, there is some evidence that large, mature cottonwoods in mixed-species forests are used as breeding sites by cerulean warblers (*Dendroica cerulea*), a species of concern to the U.S. Fish and Wildlife Service and Partners in Flight (P. B. Hamel, U.S. Dep. Agric. For. Serv., pers. commun.).

For a select group of plants, fast-growing trees facilitate seed dissemination into reforested areas by providing perches for frugivorous birds (McClanahan and Wolfe 1993). Thus, plant species diversity within these stands is enhanced (Robinson and Handel 1993) and succession is accelerated (McClanahan and Wolfe 1993).

For many private landowners, the short interval between planting and harvest of fast-growing species is as important as the wildlife benefits they provide. Although the return on the initial investment when planting oaks may be large, many landowners cannot survive the 30- to 50-year period of time required for return on their investment. Fast-growing species harvested for pulpwood, biofuel, or other products, however, can provide income, from either partial or complete harvests, in ≤10–12 years.

Reforestation with fast-growing trees also provides a readily identifiable 3-dimensional forest in only 2–3 years (Fig. 2). On the other hand, many oak plantings have the appearance of grasslands for half a decade or longer (Fig. 3). Public land managers, as well as their corporate counterparts, may accrue increased public support for reforestation efforts when the time frame allows people to see rapid transformation from cropland to emerging forest.

Fig. 2. Planted cottonwoods on an Issaquena County, Mississippi, site at the beginning of their second growing season, 15 months after planting.

Fig. 3. A Madison Parish, Louisiana, site 5 years after direct seeding to oaks using mechanical planter.

Conclusion

In conclusion, we believe that, when reforesting agricultural sites, planting fast-growing tree species, alone or in concert with heavy-seeded species, represents a superior alternative to monotypic plantings of oaks. Fast-growing trees can rapidly provide habitat for forest-breeding, Neotropical migratory birds and enhance forest diversity. Reforestation using fast-growing species on private lands provides quick financial return through harvest of pulpwood. And finally, the public is better able to perceive and support reforestation efforts when forest development is rapid.

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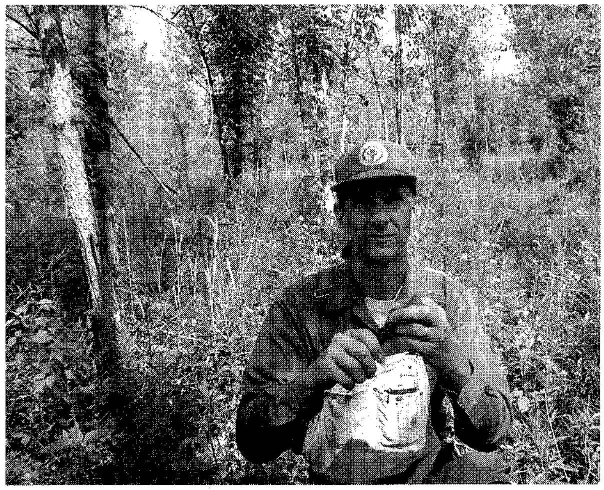

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