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Increasing biodiversity in intensively managed loblolly pine plantations: A literature review

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*Most of the forestland in the South is in private ownership, and much of it is comprised of intensively managed plantations of fast-growing loblolly pine (*Pinus taeda*). This has raised concerns about the maintenance of biodiversity, as today's dense plantations are very different from the open pine stands that were historically prevalent and now recognized for the diversity of habitat they provided (Bragg 2002, Noss 1988). Despite these differences, plantations can still make significant habitat contributions, and because of their dominance on the landscape, they will be an important part of any strategy to conserve biodiversity in the region (Hartley 2002). A number of stand level management changes can significantly enhance biodiversity values in these plantations. This fact sheet summarizes a review of the literature that identifies a spectrum of practices for supporting increased biodiversity in intensively managed loblolly pine plantations.*

The key to supporting a variety and abundance of species is to provide a diversity of structure and vegetation (Allen et al. 1996, Sharitz et al. 1982). In particular, an open, park-like structure with a rich, herbaceous understory similar to historical, fire-maintained pine communities can provide for a broad suite of plants and wildlife. Even the most intensely managed plantations often have high diversity in the early years when the canopy is still open, but this diversity decreases rapidly as the canopy closes and the stand enters the dark stem exclusion stage (Baker and Hunter 2002). Management strategies to increase biodiversity should minimize this stage, maintaining a more open canopy and productive understory throughout the rotation.

One approach to a more open structure is planting at a wider spacing, but planting dense with subsequent thinnings may be a more desirable approach for maintaining wood quality (Van Lear et al. 2004). Thinning early and often is widely recognized as an important component of an overall strategy to increase biodiversity (Hunter 1990, Marion et al. 1986). Thinning has been found to benefit numerous species, including deer (Halls 1973), quail (Dougherty 2004), small mammals (Mengak and Guynn 2003), turkeys (Mississippi State University Extension Service 2004), and birds (Turner et al. 2002). Thinning is recommended as early as 15 years (Van Lear et al. 2004) or even earlier in the absence of a pre-commercial thinning (Hurst and Warren 1980). Thinning should be repeated as frequently as every 5-10 years to maintain an open stand structure, and it should be heavier (e.g. 60-80 ft^2/acre of residual basal area) than is generally done for timber production (Halls 1973, Schultz 1997, Van Lear et al. 2004).

A potential problem with heavy thinning to maintain an open canopy is that it not only promotes herbaceous understory growth but also hardwood growth. These hardwoods can form a dense midstory that shades out the herbaceous understory (Blair and Feduccia 1977, Dickson and Wigley 2001, Hunter 1990, Schultz 1997). Thus, without hardwood control, the biodiversity benefits of thinning may be negated. In earlier times, the hardwoods in natural pine stands were controlled by

frequent low-intensity fires (Noss 1988, Van Lear et al. 2004). Managers can achieve similar results by using prescribed burning in conjunction with thinning.

Once the crop trees are large enough to survive the fire, prescribed burning at approximately 5-year intervals can help maintain favorable conditions for biodiversity (Halls 1973, Mississippi State Extension Service 2004, Schultz 1997, Marion et al. 1986). Many of the plants and animals associated with southern pine communities are adapted to or even dependent on fire, and wildlife mortality from fire is generally very low (Landers 1987, Means and Campbell 1981, Moorman 2002). Regular burning improves habitat for many species, including deer (Dickson 1982), quail (Dougherty 2004), turkey (Mississippi State University Extension Service 2004), and amphibians and reptiles (Means and Campbell 1981). However, prescribed burning should not be overdone or the effects on biodiversity may become negative (Dickson 1982, Melchiors 1991). Also, to help provide for a broad suite of species in the short and long term, areas should not be burned evenly, but patches of unburned areas should be left to provide for nesting and cover (Landers 1987, Moorman 2002).

Although a dense hardwood midstory is undesirable because it inhibits the herbaceous understory, some hardwoods are beneficial for biodiversity. Mature hardwoods such as oaks provide hard mast that is important for many wildlife species (Dickson 1982, Dickson and Wigley 2001). Maintaining a desirable component of mast-producing hardwoods will improve wildlife habitat (Johnson et al. 1975, Melchiors 1991, Tappe et al. 1993). This includes not only individual hardwoods, but also areas of hardwoods. An interspersion of hardwood and pine forest types provides good wildlife habitat (Shultz 1997), and hardwood areas should be maintained in sensitive areas such as bottomlands, drainages, and along streams (Dickson 1982, Halls 1973, Johnson et al. 1975).

Site preparation techniques at the beginning of the rotation should also be considered when managing for biodiversity. Intensive site preparation can accelerate canopy closure and reduce the availability of fruit and forage for wildlife (Hunter 1990). Thus, while intensive site preparation can benefit some game species like deer, less intensive site preparation is generally better for a diversity of wildlife (Marion and Harris 1982, Marion et al. 1986). Locascio et al. (1990) found that moderate intensity site preparation produced the greatest understory biomass, and moderate intensity treatments may be the most cost effective, especially for non-industrial landowners.

Another way to support increased biodiversity in pine plantations is by retaining key structural features such as snags, coarse woody debris, and mature live trees. These elements add additional structural complexity that benefits a wide range of wildlife (Allen et al. 1996, Baker and Hunter 2002, Dickson and Wigley 2001, Marion et al. 1986, Sharitz et al. 1992). Maintaining riparian buffers can provide for some of these elements (Dickson and Wigley 2001, Thill 1990). Riparian buffers further contribute to biodiversity by providing for aquatic species, water quality, and habitat connectivity (Baker and Hunter 2002, Dickson and Wigley 2001).

All of the management practices described above will be most effective if done in conjunction with longer rotations. Short rotation management limits pine plantations to early successional structures and does not provide for species needing older seral stages (Johnson et al. 1975). Because of the dominance of short rotations, older seral stages are becoming rare in the region (Allen et al. 1996). Longer rotations can provide for long-term wildlife forage as well as key habitat elements such as hardwood mast, snags, and cavities (Melchiors 1991).

Summary:

Certain stand-level management practices can increase the potential contribution of intensively managed loblolly pine plantations to biodiversity in the South. Thinning and prescribed burning should be done early and often to maintain an open structure and rich, herbaceous understory similar to the historically prevalent longleaf pine stands. Site preparation should be less intensive, and key structure elements such as hardwood mast and dead wood should be maintained. These practices will be most effective over longer rotations. Several additional considerations should be made when managing for biodiversity. Site specific factors will impact results, such as land use history—old field sites are unlikely to support biodiversity regardless of management practices (Baker and Hunter 2002, Hedman et al. 2000, Marion and Harris 1982, Marion et al. 1986). Economic trade-offs should also be considered. Management strategies that balance biodiversity with economic objectives are more likely to be adopted on private ownerships. Such strategies can be developed as management templates to guide landowners in achieving multiple objectives (see RTI Fact Sheet 38).

A complete literature review of practices to support increased biodiversity in intensively managed loblolly pine plantations is available in Technical Report C of RTI Working Paper #5: http://www.ruraltech.org/pubs/working/ncssf/tech_c/index.asp

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