

Oak Forest (Including Mixed Hardwoods And Pine)

Piedmont Ecoregion

This habitat includes all mature Piedmont forests found upslope, or on drier sites, than Mesic Forest and downslope, or on wetter sites, than Dry Coniferous Woodland. Immature forests will be discussed in the Early Succession habitat section. Within this moisture gradient, there is a wide range of composition of the plant community, ranging from pine-dominated to hardwood-dominated forests, depending primarily upon soils and management history.

According to Brown and Sheffield (2003) about 52% (5.4 million acres) of the Piedmont was forested in 2002 (all forest types combined). Seventy four percent (4.0 million acres) of Piedmont forests were classified as hardwood. Within hardwood forests, oak-hickory was the most widespread (2.7 million acres), followed by oak-pine (1.1 million acres) and oak-gum-cypress (151,000 acres). Pine forests accounted for 1.4 million acres, dominated by loblolly pine (798,000 acres), Virginia pine (404,000 acres) and shortleaf pine (132,000 acres). Planted stands comprised 12 percent (640,000 acres) of the total area of timberland in the Piedmont with 473,000 acres in pine plantations and 167,000 acres classified as planted oak-pine stands.

A variety of natural communities recognized by the NC Natural Heritage program have an oak-hickory or mixed hardwood/pine component and occur in the Piedmont on both xeric and mesic sites. The communities with the largest or best examples include Dry Oak-Hickory Forest, Dry-Mesic Oak-Hickory Forest, Basic Oak-Hickory Forest, Xeric Hardpan Forest and Piedmont Monadnock Forest (Schafale and Weakley 1990).

Dry-Mesic Oak-Hickory Forests and Dry Oak-Hickory are the most natural community types of the Piedmont landscape, occurring on ridgetops, upper slopes, south-facing slopes and other dry to mesic upland areas with acidic soils. They are dominated by a variety of oak and hickory tree species, but pines may also be an important component of both communities. Shrub layers are variable in density, but herbs are usually sparse (Schafale and Weakley 1990). Both of these forests are naturally uneven-aged forests with some old trees present. Reproduction typically occurs in canopy gaps and although the historical fire regime is largely unknown, fires (mostly of low intensity) certainly occurred periodically (Schafale and Weakley 1990).

Piedmont Monadnock Forests occur on monadnocks or high ridges and have a canopy dominated by chestnut oak, although other oaks are also present. The Xeric Hardpan community is found at scattered locations throughout the Piedmont, and the canopy is often dominated by post oak and blackjack oak. Basic Oak-Hickory Forest is also found scattered throughout the Piedmont on slopes, ridges and uplands with basic or circumneutral soils (Schafale and Weakley 1990).

In addition to these natural communities, there are a growing number of acres of pine plantations in the Piedmont, primarily of loblolly pine (Brown and Sheffield 2003). While there can be significant variation in the structure and composition of these pine plantations, particularly in the mid-story, the vast majority are even-aged stands with exclusively loblolly pine in the canopy. Table 1 provides a list of priority species associated with this habitat for which there are conservation concerns.

Table 1. Priority species associated with piedmont oak forests and mixed hardwood/pine stands.

Group	Scientific name	Common name	State status* (Federal status)
Birds**	<i>Accipiter cooperii</i>	Cooper's Hawk	SC
	<i>Caprimulgus vociferus</i>	Whip-poor-will	
	<i>Coccyzus americanus</i>	Yellow-billed Cuckoo	
	<i>Colaptes auratus</i>	Northern Flicker	
	<i>Contopus virens</i>	Eastern Wood-pewee	
	<i>Helmitheros vermivorous</i>	Worm-eating Warbler	
	<i>Hylocichla mustelina</i>	Wood Thrush	
	<i>Melanerpes erythrocephalus</i>	Red-headed Woodpecker	
	<i>Picoides villosus</i>	Hairy Woodpecker	
	<i>Wilsonia citrina</i>	Hooded Warbler	
Mammals	<i>Mustela frenata</i>	Long-tailed Weasel	
	<i>Scalopus aquaticus</i>	Eastern Mole	
Amphibians	<i>Ambystoma maculatum</i>	Spotted Salamander	
	<i>Ambystoma opacum</i>	Marbled Salamander	
	<i>Hemidactylium scutatum</i>	Four-toed Salamander	SC
	<i>Hyla versicolor</i>	Northern Gray Treefrog	SR
	<i>Plethodon glutinosus sensustricto</i>	Northern Slimy Salamander	
	<i>Scaphiopus holbrookii</i>	Eastern Spadefoot	
Reptiles	<i>Cemophora coccinea copei</i>	Northern Scarletsnake	
	<i>Crotalus horridus</i>	Timber Rattlesnake	SC
	<i>Elaphe guttata</i>	Corn Snake	
	<i>Eumeces laticeps</i>	Broad-headed Skink	
	<i>Lampropeltis calligaster rhombomaculata</i>	Mole Kingsnake	
	<i>Lampropeltis triangulum elapsoides</i>	Scarlet Kingsnake	
	<i>Ophisaurus attenuatus longicaudus</i>	Eastern Slender Glass Lizard	
	<i>Sistrurus miliarius</i>	Pigmy Rattlesnake	SC
	<i>Terrapene carolina</i>	Eastern Box Turtle	
	<i>Virginia valeriae valeriae</i>	Eastern Smooth Earthsnake	

*Abbreviations

SC Special Concern

SR Significantly Rare

** In pine-dominated systems under this heading, the brown-headed nuthatch and Chuck-wills-widow could also be included in the list of associated priority species.

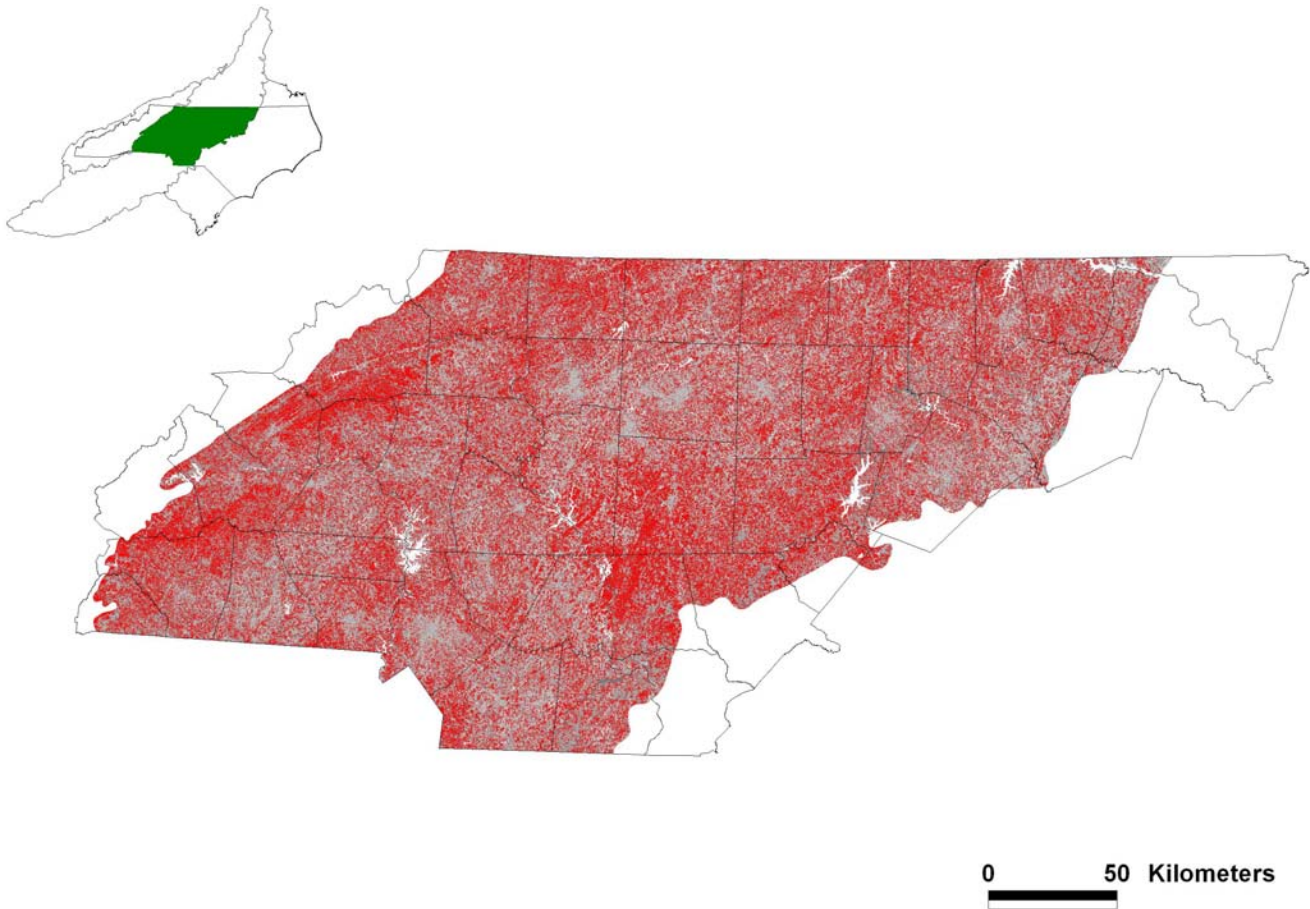
Location And Condition Of Habitat

Mature hardwood and pine forests are found throughout the Piedmont, though the total acreage has been declining in recent years. The total forested acres in the Piedmont declined 7%, or by about 400,000 acres, between 1990 and 2002, primarily due to urban development, and secondarily due to agriculture (Brown and Sheffield 2003). Map 1 depicts locations of oak forest/mixed hardwood-pine communities in the Piedmont ecoregion.

Most Piedmont forests have been logged or cleared at least once within the past 300 years, and many have been cut multiple times. The quality of existing tracts ranges widely across the Piedmont and depends primarily upon the age of the canopy trees, management history, and size of the tract (Godfrey 1997). Some tracts are too small to support viable populations of area-sensitive species or species with large home ranges or dispersal movements. In 2002, only 5.6% of the area of private forests occurred in tracts larger than 500 acres (Brown and Sheffield 2003). Land use conversions in the Piedmont (primarily to suburban and exurban development) contribute significantly to the reduced condition of some tracts. Fire suppression and conversion to pine plantations are two management activities that have most extensively impacted these natural communities.

Disturbed areas in Dry Oak-Hickory and Dry Mesic Oak-Hickory Forests have varying amounts of pines, red maple, tulip poplar and sweetgum depending on the degree of canopy opening and disturbance history. Heavily logged areas or high-graded sites have a mixture of pines and hardwoods and there are several variants present in the Piedmont. Usually these forests are uneven-aged with old trees occasionally present. Disturbances of many types, exotic plants, and fire suppression have undoubtedly changed the species composition and structure of the oak-dominated forests. The best examples of oak forests are found in the central Piedmont and often near rivers or streams (Schafale and Weakley 1990) and several small examples are protected on public lands (e.g., Caswell Game Land, Umstead State Park, Uwharrie National Forest).

Map 1. Oak forest and mixed hardwoods/pine habitat in the Piedmont ecoregion of North Carolina (in red).



Data source: NC GAP, 1992

Problems Affecting Species And Habitats

Many of the problems impacting oak and mixed hardwood/pine forests, including fire suppression and even-aged forest management, result in a loss of habitat complexity and associated wildlife niches (Hunter *et al.* 2001). Impacts include the following:

- *Development causing habitat fragmentation* - Development causes direct loss of forest habitat and also fragments remaining forested patches. Fragmentation of forests into smaller contiguous blocks is a concern for forest interior birds (like wood thrush, Cooper's hawk, and worm-eating warbler), which may occur in lower densities or suffer lower productivity or survival in small habitat patches. Animals with large home ranges or dispersal needs may become isolated or absent in small tracts. Fragmentation by roads and development can be particularly problematic for reptiles (particularly timber rattlesnake

- *Diseases* - Sudden Oak Death disease, which was detected at plant nurseries within North Carolina in 2004, could potentially have devastating impacts on oak forests across the state.
- *Short rotation forestry* - Shorter rotation forestry limits the creation of old-growth forest dynamics, such as creation of canopy gaps, hollow trees, snags, and woody debris. In 2002, less than 1% of both hardwood and pine trees in the Piedmont measured >19 inches diameter at breast height (Brown and Sheffield 2003), indicating that there are few old, large trees that help provide these old growth conditions. It should be noted, however, that tree diameter does not always correlate with tree age. Older stands will be more likely to be established and maintained on public land than on commercial forestland, though niche markets for larger timber may entice some landowners to extend cutting rotations.
- *Conversion to pine plantations* - Some native forest stands are being replaced by even-aged pine plantations, resulting in decreased habitat value for forest species that rely on diverse forest composition and structure, such as Kentucky warbler and wood thrush. Pine plantations do, however, provide increased opportunity to provide habitat for brown-headed nuthatch and bobwhite quail, with proper management.
- *Fire suppression leading to reduced or altered understory community and shifting tree species composition* - Historical data suggests that oak communities benefited from periodic fires (Abrams 1992, Close 1996), and many oak species are fire tolerant. In pine stands, fire can play a very important role in reducing the midstory while enhancing structure in the understory. Fire helps to create snags, woody debris, and canopy gaps, and prepares a fertile seed bed, while also improving vegetative structure. The benefit of fire to understory plant development is highly dependent upon the density of canopy trees, with closed-canopy stands suppressing the growth of grasses and forbs following fire. Cavity nesting birds, arboreal mammals, and some frogs, lizards and snakes are impacted by the lack of snags, while reptiles, amphibians and small mammals are impacted by lack of woody debris. Many bird species, such as hooded warbler, red-headed woodpecker, eastern wood-pewee, northern flicker, nightjars, and many post-fledging juvenile birds utilize canopy gaps for cover, or for foraging habitat, as do some bat species. Lack of fire has also allowed some fire-intolerant mesophytic plant species to become quite common in oak dominated communities including American beech (Franklin and Kupfer 2004). The resulting loss of acorn production may be limiting for some wildlife in the future.
- *Exotics* - There are many potential and realized impacts by imported gypsy moths (*Lymantria dispar*) and other non-native insects, kudzu, and other non-native pathogens, plants, and animals. Gypsy moths are the most destructive defoliating insect attacking northern red oak, chestnut oak, and white oak. This insect repeatedly defoliates trees and has killed oaks in a wide area of the northeastern United States. The Asiatic oak weevil (*Cyrtopistomus castaneus*) attacks northern red oak seedlings and has the potential to seriously affect seedling growth because the larvae feed on the fine roots while the adults feed on the foliage.

Species And Habitat Conservation Actions and Priorities For Implementation

About 5 million acres, or 93%, of the forested land in the Piedmont is owned by non-industrial private landowners (Brown and Sheffield 2003), and thus any effort to conserve species in Piedmont forests must focus on impacting private lands. Privately-owned Piedmont forests are under tremendous developmental pressure, and the highest priority for conservation of this habitat is land use planning and protection of large tracts of land. A secondary priority is controlling the impacts of introduced pests that have the potential to dramatically alter forests, with Sudden Oak Death a very high priority. The third-level conservation priority is promoting management practices that enhance habitat conditions, including selective thinnings and controlled burning.

County and state-level land use planning is needed to minimize development within large, unfragmented tracts of forests. Where development will occur, cluster development and other lower impact development approaches are urged. This would be most appropriate and effective in the regions that are, as yet, not heavily developed, including Anson, Montgomery, Stanly, Randolph and Richmond counties in the southern Piedmont, and the northern tier counties of Surry, Stokes, Rockingham, Caswell, Person, and Granville. Planning for future infrastructure (roads, water lines, etc.) should be concentrated closer to existing development and should avoid dissecting larger tracks of unfragmented forest.

The next highest priority for this habitat is direct land protection through easements and land acquisition. Attempts should be made to provide large core areas of forest and to connect isolated patches of forests. As this is the dominant vegetation type in the Piedmont, protection of large tracts (>500 acres) is recommended. Cooper and Demarest (1999) recommend that core areas be at least 16,000 acres in size to produce viable populations of forest-interior birds, like scarlet tanager. Large core areas will be important for reptiles like box turtle and timber rattlesnake, which suffer high mortality when crossing roads. State and county parks departments, the Commission, the Ecosystem Enhancement Program, The Nature Conservancy, the Piedmont Land Conservancy, the Land Trust for Central North Carolina, and other regional land trusts are all important players in land protection. The Nature Conservancy's Piedmont ecoregional plan (when completed) and the One NC *Naturally* Initiative will help to prioritize land protection efforts in the Piedmont.

Controlled burning is a beneficial habitat management practice, and should be encouraged in almost all Piedmont forest types, especially those with a pine component or a more open overstory. The greatest limitation on controlled burning is the presence of well-traveled roads, developments and sensitive agriculture operations (like chicken houses) which raise concerns over smoke management and liability. The NC Forest Service is the most important partner in promoting controlled burning. The Forest Service offers a free fire line program for private landowners, helping to dramatically defray the cost of implementing controlled burning.

Invasive and exotic species control should be targeted at ecologically sensitive areas and at new and potentially manageable outbreaks. Rapid response to new outbreaks will be critical. There are a number of management practices that can be implemented on commercial pine plantations to enhance their habitat value. Many forest managers attempt to control hardwoods in pine stands with chemicals or other means, to reduce competition with pines.

Morrison and Meslow (1983) and Santillo *et al.* (1989 *a, b*) found that retaining even small patches of deciduous trees with pine stands maintains a similar songbird community as in stands where hardwoods are not controlled. They recommend retaining these in areas of unstable soil, along roads, and as stream buffer strips. Banded or spot applications of herbicides can be used to maintain vegetation diversity and cover (Isaacson 1999). When selecting herbicides for pine release, Thomas (n.d.) recommends using Arsenal alone because legumes and blackberries are not damaged.

On large timber holdings it will be beneficial to maintain a diversity of habitat types and stand ages across the landscape and to restrict clearcut size, if benefit for forest interior species is the goal. Thinning prior to crown closure (Isaacson 1999), prescribed burning (Perkins 1962), and mid-rotation pine release using Arsenal (Thomas 1993) improve the quality and diversity of plant communities important to many wildlife species. Landowner incentives, technical assistance, and markets that promote extending rotation lengths should also be supported.

Priority Research, Survey, And Monitoring

Surveys are needed to document the distribution, relative abundance and status of many wildlife species associated with oak or mixed hardwood/pine forests. In general, inventory and trend information is most severely lacking for reptiles, amphibians, and small mammals (bats in particular), while diurnal birds are relatively well surveyed in Piedmont upland forests. Priorities for conducting surveys need to focus on species believed to be declining, at risk, or mainly dependent on oak dominated communities. Secondary priority for surveys should be for species for which current distribution information is already available or for species that are generalists in terms of habitat usage.

Monitoring systems need to be expanded and/or targeted to be able to assess current population status and trend information for all wildlife species associated with oak or hardwood/pine forests. Again, the best trend information is available for many birds, while little long-term trend data are available for amphibians, reptiles, and mammals.

• Surveys

- Document the distribution and status of forest bats. Several priority bat species, including Seminole bat, southeastern bat, hoary bat, northern yellow bat, silver-haired bat, and northern long-eared bat may occur in upland Piedmont forests, but very little work has been done to document these species.
- Document the distribution and status of priority amphibians (e.g., eastern spadefoot toad, four-toed salamanders) and document non-breeding use of oak forests by spotted and marbled salamanders.
- Document distribution and status of timber and pigmy rattlesnakes.
- Conduct nocturnal surveys to determine the status and distribution for whip-poor-will and Chuck-will's widow.
- Determine the breeding status and distribution of Cooper's hawks.

- Document status and distribution of priority reptiles (e.g., northern scarlet snake, mole kingsnake, scarlet kingsnake, corn snake, eastern smooth earth snake) and document the extent of eastern box turtle use of oak or hardwood/pine dominated forests.
- Document the distribution and rate of spread for the most detrimental invasive exotic insects, plants, and diseases.

- **Monitoring**

- Monitor tree infestations and diseases to document potentially destructive organisms shortly after they show up, while there is still a chance to contain or eradicate the pest. This effort should include monitoring of potential vectors for the introduction of new pests and diseases, including nursery and forest products.
- Monitor for exotic species spread; control may be required locally.
- Develop standardized monitoring programs analogous to the Breeding Bird Survey for reptiles, amphibians and small mammals. Of particular interest is trend information for those species dependent upon snags and woody debris.
- Establish mist-netting stations for long-term forest bat monitoring.
- Establish MAPS and migration bird banding stations to monitor population status and trends for birds not adequately sampled under existing monitoring protocols.
- Establish Migration Monitoring routes and winter surveys for birds in oak dominated forests.

- **Research**

- There is a need to develop a greater understanding of the ecological relationships between wildlife species and their habitats, as well as the biological, physical and chemical habitat components, to help better guide management and conservation efforts.

Predator effects

- Study predator impacts on nest productivity, especially for ground nesting birds.
- Examine cowbird parasitism impacts on bird productivity in small versus large habitat patches.
- Determine the interactions between fire ants and ground nesting birds, small mammals and reptiles in disturbed forests, along edges of forest, and at road/forest interfaces.

Population demographics

- Establish long-term bird nest searching and spot mapping studies on neotropical migrants like worm-eating warbler, wood thrush, hooded warbler and eastern wood-pewee.
- Determine the impacts on native wildlife populations of large-scale applications of pesticides for gypsy moths and other pests.

Habitat use

- Determine the minimum forest patch size needed to support stable populations of forest-interior birds (e.g., wood thrush and scarlet tanager), as well as basic studies of

nest success and productivity in habitat patches of different sizes, similar to studies conducted with citizen science volunteers by the Cornell Lab of Ornithology.

- Conduct productivity studies of open woodland woodpeckers (i.e. northern flicker and red-headed woodpecker).

Management practices

- Examine the feasibility of using forestry practices that mimic old growth forest dynamics (e.g., canopy gap, snag, and woody debris creation) in a manner that is compatible with economic goals of private landowners.
- Study the efficacy and wildlife impacts of thinning mature oak stands to encourage understory development.
- Compare oak forests that are managed via prescribed fire and those that are not burned at all, tracking differences in plant, wildlife and invertebrate communities.
- Study the efficacy of wildlife underpasses where habitat is highly fragmented by high volume roads.
- Develop new management techniques that control invasive exotic species while minimizing impacts on non-target species.

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