

NONRIVERINE WET HARDWOOD FORESTS IN NORTH CAROLINA STATUS AND TRENDS

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INTRODUCTION

Nonriverine Wet Hardwood Forests are among the most threatened of North Carolina's natural communities, and in some ways among the least well known. Also called oak flats, they were once widespread in the outer Coastal Plain of northeastern North Carolina, but were long ago reduced to a small fraction of their presettlement abundance. Today few citizens of North Carolina have knowingly seen and appreciated this part of the state's natural heritage.

Definition and Description

Nonriverine Wet Hardwood Forests, as defined in Schafale and Weakley (1990), are wetland forests of poorly drained, mineral soils on broad interstream flats. They correspond to the *Quercus michauxii-Quercus pagoda/Clethra alnifolia-Leucothoe axillaris* Forest and *Quercus laurifolia-Nyssa biflora* Forest associations of the Nature Conservancy's vegetation classification (Weakley, et al. 1998). They would be classified as type 91, Swamp Chestnut Oak-Cherrybark Oak in the Society of American Foresters system, along with the more common bottomland hardwoods along rivers (Eyre 1980).

Nonriverine Wet Hardwood Forests are naturally dominated by some of the same trees as bottomland hardwood forests along large brownwater rivers: sweetgum (*Liquidambar styraciflua*), swamp chestnut oak (*Quercus michauxii*), laurel oak (*Quercus laurifolia*), cherrybark oak (*Quercus pagoda*), water oak (*Quercus nigra*), loblolly pine (*Pinus taeda*), red maple (*Acer rubrum*), and tulip poplar (*Liriodendron tulipifera*). The understory, shrub, and herb layers consist primarily of plants shared with blackwater river floodplains or with pocosins and nonriverine swamp forests, though some are also shared with brownwater rivers. The most typical understory trees are red bay (*Persea palustris*), red maple (*Acer rubrum*), and ironwood (*Carpinus caroliniana*). Common shrubs are sweet pepperbush (*Clethra alnifolia*), evergreen dog hobble (*Leucothoe axillaris*), and cane (*Arundinaria gigantea* ssp. *tecta*). The dominant herbs are netted chain fern (*Woodwardia areolata*), Virginia chain fern (*Woodwardia virginica*), and royal fern (*Osmunda regalis*). Peat moss (*Sphagnum* spp.) is usually present in small amounts.

Animals include widespread species such as white-tailed deer, black bear, and gray squirrel. The large oak component makes Nonriverine Wet Hardwood Forests potentially excellent habitat for wild turkeys. The multi-layered structure characteristic of mature Nonriverine Wet Hardwood Forests supports high densities and diversities of neotropical migrant birds such as wood thrush, ovenbird, Swainson's warbler, worm-eating warbler, prothonotary warbler, hooded warbler, and white-breasted nuthatch. In the outer Coastal Plain, where large river floodplains with bottomland hardwoods are absent, the once-extensive Nonriverine Wet Hardwood Forests may have once supported much larger populations of these species than now occur in this region.

Invertebrates of these communities have not been studied, but it is likely that a suite of insects specialized to feed on oaks and a suite of soil organisms adapted to the unique hydrological conditions are present.

In contrast to bottomland hardwood forests along rivers, wetland conditions in Nonriverine Wet Hardwood Forests are caused by the limited runoff of rainfall, due to flatness and natural absence of streams. Rheinhardt and Rheinhardt (1998a) found that soil drainage class in this type did not correlate with soil texture as is common in many places, but was more subject to topography and landscape position. The soil is generally saturated or flooded with a few inches of water through most winters and well into the early summer, and the lower soil probably remains moist through most summers. The water never gets as deep as it may be in river floodplains, but the soil undoubtedly stays saturated longer than in bottomland hardwoods. Furthermore, no additional nutrients are brought in by flowing water, and aquatic animals cannot move in from the river during flooded times. Thus, debris processing and nutrient cycling are likely very different from floodplain communities.

A number of other natural community types occur on wet nonriverine flats and share some characteristics with the Nonriverine Wet Hardwood Forest type. Most similar are Nonriverine Swamp Forests, which are wetter and lack oaks, but share many of the other plants. Mesic Mixed Hardwood Forests contain some of the same tree species but are drier than Nonriverine Wet Hardwood Forests and have beech (*Fagus grandifolia*) as a major component. Often the centers of nonriverine flats are so wet that organic matter has accumulated, burying the mineral soils. These peatlands support either pocosin communities, Nonriverine Swamp Forests, or Peatland Atlantic White Cedar Forests. Fires were an important part of the natural dynamics of the pocosin and white cedar communities. Fire is believed to have been much less frequent in Nonriverine Wet Hardwood Forests, due to the limited flammability of the leaf litter and lack of continuous live fuel layers, but they certainly would have burned with low intensity surface fires at times. Fire has not been believed to be important to Nonriverine Wet Hardwood Forests or Nonriverine Swamp Forests, but Rheinhardt and Rheinhardt (1998a) suggest it may play a significant role in maintaining dominance of oaks over other hardwoods.

A typical natural landscape pattern on the largest nonriverine flats is a complex of peatland communities in the center of the flat, with a fringe of Nonriverine Wet Hardwood Forest where the peat gives way to wet mineral soils, then a band of upland communities on the gentle slopes closer to the streams, then stream swamps and tidal swamps and marshes along the drainages. On some of the smaller flats farther inland, no peat may be present, and Nonriverine Swamp Forest and Nonriverine Wet Hardwood Forest on mineral soils may be in the center of the flat. Because the easiest lands to drain and convert to other uses are the least wet and those close to slopes, the Nonriverine Wet Hardwood Forests were generally among the first wetlands to be put into agriculture and later intensive silviculture.

The primary range of Nonriverine Wet Hardwood Forests is northeastern North Carolina. They range from Craven County north into the southeastern counties of Virginia. None are known south of North Carolina or north of Chesapeake Bay. Although one example was known inland nearly to Tarboro, the vast majority of acreage was, and is, on the outermost terrace of the Coastal Plain, east of New Bern, Washington, and Plymouth.

The Nonriverine Wet Hardwood Forest community type corresponds to two associations in the Nature Conservancy National Classification: *Quercus michauxii-Quercus pagoda/Clethra alnifolia-Leucothoe axillaris* Forest and *Quercus laurifolia-Nyssa biflora/Clethra alnifolia-Leucothoe axillaris* Forest (Weakley et al. 1998). Its closest equivalent in the Society of American Foresters cover type classification is type 91: Swamp Chestnut Oak-Cherrybark Oak, a bottomland hardwood type (Eyre 1980).

Composition and Quality of Nonriverine Wet Hardwood Forests

Most early and more recent qualitative descriptions of Nonriverine Wet Hardwood Forests describe them as being dominated by oaks. The only extensive quantitative study of Nonriverine Wet Hardwood Forest composition is that recently completed by Rheinhardt and Rheinhardt (1998b). They measured canopy and understory basal area and density in most of the known remaining examples in North Carolina. In contrast to earlier qualitative descriptions, they found essentially all stands dominated by sweetgum, red maple, or tulip poplar. Oaks were abundant, but only in a few places were they codominant.

Sweetgum, red maple, and tulip poplar are, ecologically speaking, weedy species, producing abundant, small, widely dispersed seeds, and able to take advantage of disturbance much more readily than oaks. It is therefore likely that, although these native species have always been present, they have increased in absolute and relative abundance as a result of logging. Thus, although the precise composition of the natural forests is not well known, examples with more oak are believed to be closer to natural composition and therefore of higher natural quality. This belief is supported by the abundance of oak saplings in examples that contain a strong minority of oak in the canopy, suggesting that over time without severe disturbance oaks will increase in the forest. The presence and abundance of oaks therefore serves both as an indicator that a community is a Nonriverine Wet Hardwood Forest rather than a Nonriverine Swamp Forest and as an indicator of its natural quality. In the best remnants known, Rheinhardt and Rheinhardt (1998a, 1998b) found oaks to be 1.2% to 50% of basal area and 1.5% to 42.9% of canopy stem density. Given current conditions, examples with oaks comprising more than 10% of the basal area or of the canopy cover should be considered good examples. They have the best potential to recover to natural oak abundance in time, and are most likely to retain species associated with oaks.

Observations of areas clearcut in recent years indicate that they almost always regenerate to the weedy hardwoods or to loblolly pine, with essentially no oak component. Given the abundance of weedy tree species and the scarcity of oaks in the landscapes where they once were abundant, it is unlikely that oaks will ever again become abundant on these sites. Any species which are dependent on oaks are presumably eliminated. Therefore, Nonriverine Wet Hardwood Forests

that are clearcut at present must be considered lost. Those that are selectively cut may be expected to recover if a substantial amount of oak is left or if there are remnants adjacent. .

Besides abundance of oaks in the canopy and understory, other indicators of quality in Nonriverine Wet Hardwood Forests are canopy maturity, canopy age structure, extent, and connection to other natural communities. The most mature examples known have many trees 16-24 inches in diameter, with some exceeding 36 inches. However, given the scarcity of these communities, examples with trees averaging 12 inches in diameter are considered reasonably mature. Even those with trees averaging 8 to 10 inches in diameter are significant if the canopy composition is good and the example is extensive. The natural canopy is believed to be uneven-aged, with trees reproducing primarily in small to medium canopy gaps that formed periodically from storms and possibly fires, and with old trees abundant. In no remaining examples is this structure well developed, but it can be expected to develop over time in the oldest examples. Examples with some canopy gaps containing oak saplings, or with large old trees that will form canopy gaps in the near future, will have more of the characteristics of natural forests than those with uniform younger canopies. Nonriverine Wet Hardwoods naturally occurred in large patches, and some aspects of ecosystem function probably depend on large extent. Therefore, large examples are more likely viable and are more significant than small examples.

CURRENT STATUS OF NONRIVERINE WET HARDWOOD FORESTS

Methods

The study by Rheinhardt and Rheinhardt (1998b) allowed thorough updating of the Natural Heritage Program database for Nonriverine Wet Hardwood Forest, creating a good picture of the amount and condition of the remnants in North Carolina. They attempted to sample every known example, and examined aerial photos and consulted with foresters to determine the status of examples they were not allowed to visit. The Natural Heritage database was updated from their acreage figures and sample data, examples found to be destroyed were removed, and quality ratings of the occurrences were updated. These ratings (EO ranks) are based on a combination of condition and size, using the criteria described above. I reevaluated the classification of the existing records, and reclassified a couple that had been called Nonriverine Wet Hardwood Forest by mistake. In the few cases where Rheinhardt and Rheinhardt's report did not give the condition of the site, I attempted to determine its status by personal communication with them and by consulting aerial photos. Sites not confirmed to be destroyed were assumed extant, possibly resulting in an overestimate of amount remaining. An overestimate may also result in cases where Rheinhardt and Rheinhardt did not visit but were forced to rely on aerial photos which were already several years old.

Results

Table 1 lists the known sites, and Map 1 shows their distribution. A total of 24 separate sites for Nonriverine Wet Hardwood Forest communities are known to the Natural Heritage Program. These occurrences total approximately 3870 acres. Of these, six sites have quality rankings of A, six have rankings of B, eleven have rankings of C, and one is too little known to rank. Only eight sites are 100 acres or larger. Only four exceed 500 acres, and only one, Scranton Hardwoods, still seems to cover as much as 1000 acres. The greatest concentration of separate

remaining sites is in the counties north of Albemarle Sound, especially Currituck County. However, the largest remaining acreage is in Hyde County, followed closely by Pamlico County.

Of the 24 sites, only three are under any kind of protective designation. All three are small, and the three together total less than 100 acres. They include the Gum Swamp special interest area on Croatan National Forest, a small area on Great Dismal Swamp National Wildlife Refuge, and one private tract. All three are on the state's Registry of Natural Heritage Areas, based on voluntary protection agreements that are not legally binding. An additional site, Indiantown Creek/North River Cypress Forest, is likely to be dedicated, a more permanent form of protection. Two more examples are on state lands -- on Gull Rock Game Land and Tidewater Research Station, but they do not have any designation that ensures their long term protection. Indeed, the Tidewater Research Station occurrence was damaged within the last year by logging operations occurring on adjacent state lands. No examples are owned by private conservation groups. Even counting the public lands without protective designation, less than 6% of the remaining total acreage is in any conservation status.

TRENDS IN NONRIVERINE WET HARDWOOD FOREST LOSS

Methods

While an impression of continued loss of the few remaining examples has been created by the periodic discovery that a known example had been destroyed, it has been difficult to determine trends more precisely. The best time for a snapshot of overall status to compare with the current update is around 1990. Natural area inventories conducted as part of the Albemarle/Pamlico Estuarine Study (Frost, Legrand, and Schneider 1990; LeGrand, Frost, and Fussell 1992) covered all of the range of Nonriverine Wet Hardwood Forest in North Carolina. Most of the field work for these studies was conducted in 1989 and 1990. More of the known occurrences were found during these studies than at any other single time. The occurrences were recorded in the Natural Heritage Program database when the studies were completed, and some occurrences were visited and the records updated over the years.

I reconstructed the status of Nonriverine Wet Hardwood Forest around 1990 by estimating acreage for all the examples we have evidence of having existed at that time. This includes ones still known to exist, ones known to have been destroyed since 1990, and a few discovered since 1990. Records that were thought to be Nonriverine Wet Hardwood Forest at the time and were later determined to be other community types were not included. There are several potential sources of error in this list, all leading to underestimation of the amount existing at that time and therefore underestimation of the amount lost. Examples discovered after 1990 may have been larger in size in 1990 than when they were discovered. In addition, some examples likely were destroyed between 1990 and the present without ever becoming known to the Natural Heritage Program.

To get an indication how much Nonriverine Wet Hardwood Forest may have once been present, I analyzed digitized soil survey maps for two sample counties, Hyde and Currituck (USDA-

NRCS 1996 and 1997). Acreage of all soil series believed to support large areas of Nonriverine Wet Hardwood Forest in the past was determined by GIS. The list of soils to include in the acreage started with those series mapped under known remnant Nonriverine Wet Hardwood Forest occurrences. Series were rated by the fraction of their acreage that probably supported Nonriverine Wet Hardwood Forest, based on what communities they support in remnant natural areas. Those that were rated low were those that appeared only once or twice and occurred more often with other community types; these were not used in calculating acreage. The Nonriverine Wet Hardwood Forests probably occur on inclusions within these map units or Nonriverine Wet Hardwood Forests occur on these soils only in unusual circumstances. Additional series not represented by remnants were added to the list if they were taxonomically very close to series on the list and were not known to support other community types. This was particularly important in Hyde County, where the soil survey was done more recently and used newly defined series that could not be associated with remnants in other counties. Acreage totals were calculated for high rated soils alone and for high and medium rated soils together. The former can be expected to be a serious underestimate of the amount of Nonriverine Wet Hardwood Forest once present, the latter an overestimate.

Results and Discussion

Based on the Albemarle/Pamlico Estuarine Study surveys and other information, a total of 29 sites are known to have existed around 1990, totaling about 8150 acres (Table 2). Of the 29 sites, five were completely destroyed or degraded beyond viability by 1998. An additional nine had their acreage substantially reduced. Overall, at least 4275 acres of Nonriverine Wet Hardwood Forest were lost, 52% of the amount documented as existing in 1990. An additional three sites had selective cutting or other disturbance that reduced their natural quality. The largest loss occurred in the counties north of Albemarle Sound, where 2815 acres of this community type were lost, 78% of the 1990 total for this region. However, major losses occurred throughout the range. There has been a loss of the largest sites; of the four sites with over 1000 acres in 1990, only one remained over 1000 acres in 1998.

Given the limitations of Natural Heritage inventories, some additional examples of Nonriverine Wet Hardwood Forest probably remain undiscovered. During the eight years since 1990, four new occurrences were found. These totaled 141 acres, with the largest being 90 acres. There is therefore some hope that additional occurrences will be found, but these are unlikely to be anywhere as large individually or in total as the sites now known.

The ultimate fate of land formerly supporting Nonriverine Wet Hardwood Forest was often not clear in this study. Most sites that were lost had obviously been clearcut when viewed on aerial photos or were reported to have been clearcut by county foresters. A few appeared to have been developed or converted to cropland. Some were found to have been converted to pine plantations. It is likely that many of the other clearcut sites were also converted to pine plantation after the aerial photo was taken. Clearcut sites that are not converted can be expected to regenerate to weedy hardwoods or pine and are unlikely to recover to their previous composition.

Soil series used in estimating past abundance of Nonriverine Wet Hardwood Forest are listed in Table 3. Six were rated as high (primarily supporting Nonriverine Wet Hardwood Forest) and three as medium (supporting extensive Nonriverine Wet Hardwood Forest but also probably supporting substantial amounts of other communities). Acreage of these series is given in Table 4. Based on these estimates, Hyde County had between 34961 and 50586 acres of Nonriverine Wet Hardwood Forest. Currituck County had 15317 to 43941 acres. The most extensive of the medium-rated series, Roanoke, probably supported Nonriverine Wet Hardwood Forest on a majority of its acreage, but is also known to support significant amounts of Mesic Mixed Hardwood Forest. It is likely that the true estimate, at least for Currituck County, is closer to the higher figure. This is more difficult to evaluate for Hyde County, where substantial acreages of soil series cannot be compared to other counties.

While there is high uncertainty in the estimates of original acreage based on soils, this analysis shows the drastic loss of Nonriverine Wet Hardwood Forest. Currituck County alone, one of the smallest counties in North Carolina, once had several times, perhaps ten times, as much Nonriverine Wet Hardwood Forest as now remains in the whole state. Much of the loss occurred long ago, as the most easily converted lands were put into agriculture or repeatedly logged. However, recent losses are still proportionally high, with more than 50% of acreage lost in less than a decade. While this study did not compare this rate of loss in recent times to other community types, it appears to exceed that of virtually all other community types. In overall portion lost from original extent, it is comparable to the losses of wet and mesic longleaf pine savannas, and probably exceeds that of any other wetland community type. In percentage of remaining examples unprotected and likely to be lost in the near future, it far exceeds longleaf pine communities and virtually all other community types in the state. Unlike many wetland community types, the recent trends show that the potential for activities that will destroy or severely compromise the natural integrity of remnants remains high. By any measure, Nonriverine Wet Hardwood Forests are among the most endangered natural community types in North Carolina.

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Table 1. Remaining Nonriverine Wet Hardwood Forest sites in North Carolina. EO ranks are from the May 1998 Natural Heritage Program database. A is excellent, B very good, C fair, E uncertain. Size figures are in acres.

site name	county	EO rank	size	protection
Jackson Swamp Remnants	Beaufort	AB	165	
Roquist Pocosin	Bertie	AB	31	
Whitehall Shores Hardwood Forest	Camden	C	100	
Gum Swamp Bottomland Hardwoods	Craven	B	40	registered federal land, Forest Service special interest area
Sea Gate Woods	Craven	C	85	
Buckskin Creek/Great Swamp	Currituck	C	100	
Lower Tull Creek Woods and Marsh	Currituck	C	30	
Indiantown Creek/North River Cypress Forest	Currituck	A	48	state-owned, to be dedicated
Gibbs Woods/Tull Bay Marshes	Currituck	C	135	
Troublesome Point/Gibbs Point Forests and Marshes	Currituck	C	40	
Great Dismal Swamp National Wildlife Refuge	Gates	BC	5	registered federal land
Scranton Hardwood Forest	Hyde	A	1000	
Gull Rock Game Land	Hyde	BC	20	state-owned
South Prong Natural Area	Pamlico	B?	35	
Light Ground Pocosin Southeast Section	Pamlico	C	60	
Merritt Hardwoods	Pamlico	A	900	
Little Flatty Creek Forests	Pasquotank	C	40	registered private land
Big Flatty Creek Forests and Marshes	Pasquotank	E	300	
Menzies Pond	Perquimans	B	20	
Belvoir Carolina Bays and Flats	Pitt	C	34	
Bethel/Grindle Hardwood Flats	Pitt	A	530	
Lewis Point Swamp Forest	Tyrrell	C	15	
Highway 99 Nonriverine Hardwood Flat	Washington	BC	50	
East Dismal Swamp	Washington	C	90	state-owned
total 24 sites	13 counties		3873	

Table 2. Change in Nonriverine Wet Hardwood Forest from 1990 to 1998. EO ranks are based on 1998 condition.

site name	county	EO rank	1990 size	1998 size	status change
Jackson Swamp Remnants	Beaufort	AB	165	165	
Roquist Pocosin	Bertie	AB	31	31	newly discovered
Whitehall Shores Hardwood Forest	Camden	C	100	100	
Forest Wet Hardwood Forest	Craven		138	0	destroyed
Gum Swamp Bottomland Hardwoods	Craven	B	40	40	
Sea Gate Woods	Craven	C	280	85	part destroyed
Buckskin Creek/Great Swamp	Currituck	C	420	100	part destroyed
Lower Tull Creek Woods and Marsh	Currituck	C	120	30	part destroyed
Indiantown Creek/North River Cypress Forest	Currituck	A	48	48	
Gibbs Woods/Tull Bay Marshes	Currituck	C	135	135	selectively cut
Maple Swamp Gordonia Forest	Currituck		40	0	destroyed
Northwest Backwoods	Currituck		900	0	destroyed
Troublesome Point/Gibbs Point Forests and Marshes	Currituck	C	40	40	part selectively cut
Mildred Wet Hardwood Flat	Edgecombe		40		bought for wetland mitigation after site was destroyed by highway construction, borrow pit, and clearcut
Black Mingle Pocosin	Gates		150	0	destroyed
Great Dismal Swamp National Wildlife Refuge	Gates	BC	5	5	
Scranton Hardwood Forest	Hyde	A	1000	1000	some limited cutting may have occurred
Gull Rock Game Land	Hyde	BC	20	20	
South Prong Natural Area	Pamlico	B?	35	35	
Light Ground Pocosin Southeast Section	Pamlico	C	60	60	part destroyed in 1980s
Merritt Hardwoods	Pamlico	A	1400	900	part destroyed, more destroyed in 1980s
Little Flatty Creek Forests	Pasquotank	C	185	40	part destroyed, part registered
Big Flatty Creek Forests and Marshes	Pasquotank	E	1500	300	part destroyed
Menzies Pond	Perquimans	B	20	20	
Belvoir Carolina Bays and Flats	Pitt	C	85	34	part destroyed
Bethel/Grindle Hardwood Flats	Pitt	A	1080	530	part destroyed

Lewis Point Swamp Forest	Tyrrell	C	15	15	newly discovered, some additional area may have been clearcut since 1990
Highway 99 Nonriverine Hardwood Flat	Washington	BC	50	25	part destroyed
East Dismal Swamp	Washington	C	90	90	damaged by logging of adjacent area
total 29 sites	14 counties		8148	3873	5 sites destroyed, 9 partly destroyed

Table 3. Soil series of Nonriverine Wet Hardwood Forest occurrences and additional series likely to have supported Nonriverine Wet Hardwood Forest. Rating is an estimate of the fraction of the soil series acreage that would have supported Nonriverine Wet Hardwood Forest.

series	taxonomy	sites	rating
Acredale	Typic Endoaqualf	Scranton	high
Arapahoe	Typic Humaquept	Merritt Hardwoods	low
Argent	Typic Endoaqualf	Light Ground Pocosin Southeast, South Prong, Scranton Hardwoods	high
Brookman	Typic Umbraqualf	Scranton	med.
Cape Fear	Typic Umbraquult	Highway 99 Hardwood Flats, Belvoir Carolina Bays	high
Deloss	Typic Umbraquult	Sea Gate Woods	low
Hydeland	Typic Umbraqualf	Scranton	med.
Leaf	Typic Albaquult	Roquist Pocosin, Gum Swamp	low
Pantego	Umbric Paleaquult	Gum Swamp	low
Pasquotank	Typic Endoaqualf		high
Portsmouth	Typic Umbraquult	Jackson Swamp Remnants	low
Roanoke	Typic Endoaquult	Whitehall Shores, Sea Gate Woods, Gibbs Woods/Tull Bay, Troublesome Point, Lower Tull Creek, Buckskin Creek/Great Swamp, Big Flatty Creek, Little Flatty Creek, Menzies Pond, Bethel/Grindle, East Dismal Swamp	med.
Tomotley	Typic Endoaquult	Indiantown Creek, Lewis Creek	high
Yonges	Typic Endoaqualf		high

Table 4. Amount of soils likely to have supported Nonriverine Wet Hardwood Forest in Hyde and Currituck counties. Rating is an estimate of the fraction of the soil series acreage that would have supported Nonriverine Wet Hardwood Forest.

series	Hyde	Currituck	rating
Argent	9467		high
Acredale	12425		high
Brookman	7777		medium
Cape Fear		6104	medium
Hydeland	17848		medium
Pasquotank	590	1509	high
Roanoke		28624	medium
Tomotley		6104	high
Yonges	2479		high
total	50586	43941	
total of high probability only	24961	15317	

Map 1. Locations of Nonriverine Wet Hardwood Forest community occurrences remaining in North Carolina in 1997.

