

include species such as yellow buckeye (Aesculus sylvatica), pawpaw (Asimina sp.), bellwort (Uvularia perfoliata), false solomon's seal (Smilacina racemosa), black cohosh (Cimicifuga racemosa), and rattlesnake root (Prenanthes sp.). In the deep ravine just to the west of the King's Mill Rhododendron Bluff (M12), grows the sweet pinesap (Monotropsis odorata), a montane disjunct in our area that is considered significantly rare within the state.

A unique habitat present in this tract is an extensive vernal pool, filling only with rainwater and having no inlet or outlet. Probably situated on a clay pan, few plants grow here. The only trees present are willow oak (Quercus phellos) and sweet gum (Liquidambar styraciflua), both typical bottomland species and rarely present on dry ridge crests. The shrub and herb layers are nearly absent, composed primarily of tangles of greenbrier (Smilax rotundifolia); sparkleberry (Vaccinium arboreum) occurs along the margin.

In the winter, this pool serves as an important breeding site for the spotted salamander (Ambystoma maculatum) and marbled salamander (A. opacum), both of which require isolated, fish-free ponds for their larval development; like the willow oaks, they are uncommon on dry ridge crests. Wildlife more typical of the uplands include the ovenbird (Seiurus aurocapillus), scarlet tanager (Piranga olivacea), red-tailed hawk (Buteo jamaicensis), hairy woodpecker (Picoides villosus), and pileated woodpecker (Dryocopus pileatus), all of which serve as indicators for the extent of this forested area. The eastern box turtle (Terrapene carolina) also occurs here in large numbers, again indicating the relative lack of disturbance; this population served as the subject for the doctoral research of one of the current authors (Hall, 1987). Other animals worth noting are the hooded warblers (Wilsonia citrina), present on this upland tract due to the extensive viburnum thickets (occurring especially at the head of Yancey Brook), and the well-developed community of amphibians also present in Yancey Brook, including the dusky salamander (Desmognathus fuscus), red salamander (Pseudotriton ruber), two-lined salamander (Eurycea bislineata), three-lined salamander (E. guttolineata), and green frog (Rana clamitans). Wild turkey (Meleagris gallopavo) has also been reported to occur in this area.

Protection Status: None

Surrounding land use:

- N: NC Botanical Garden
- E: Mason Farm Biological Reserve, private forest
- S: Residential
- W: Residential

Threats:

- Immediate: Development for housing
- Potential: Same

Recommendations for management or protection: Several of the

sites on this ridge deserve special protection, including the vernal pool, the ravine in which the sweet pinesap occurs, and the slopes bordering the Mason Farm Southern Shagbark Forest (M16) and the rhododendron communities (M11, M12, M14); conservation easements should be negotiated for these sites in particular (purchase by the University would be the ideal option -- the Mason Farm Biological Reserve does not itself include any ridgetop habitats).

Ownership: See Appendix A

Documentation References: Jones, 1980; Hall, 1987.

Overview of the Mason Farm Biological Reserve

One of the premier natural areas in the eastern Piedmont, the Mason Farm Biological Reserve is a tract of 367 acres of undeveloped, university-owned lands located in the southeast corner of Orange County. Although the property was one of the first to be settled in the Piedmont, originally homesteaded in the 1740's by the Morgan family, it has remained largely undisturbed since 1894 when it was willed to the University by Mary Mason, one of the last descendants of the Morgans. Since the time of the bequest, much of the area has reverted to woodlands. Some of the forests are now at least 150 years old (some individual trees are certainly much older), and are the most mature stands remaining in the county. Somewhat less "natural" but preserving a fast-disappearing element of the rural Piedmont, several of the historic fields of the Mason Plantation are still kept under cultivation through leases with local farmers; planting is rotated, however, allowing some fields to lie fallow and begin to enter secondary succession.

Since the 1960's, several portions of this tract were set aside specifically for biological uses by the UNC Board of Trustees, and the Mason Farm Biological Reserve was officially established in 1984. Today the area is administered by the North Carolina Botanical Garden as both a natural area and biological field station. Since 1975, 48 research projects have been conducted in the natural areas of the Reserve, including 28 graduate projects, 18 of which resulted in doctoral degrees in biology.

In addition to the large amounts of land contained within the Reserve itself, the value of the natural area is further enhanced by the even larger tracts of undeveloped land that surround and buffer the Reserve on all sides. To the north lies the Finley Golf Course, also a part of the Mason bequest to the University of North Carolina, while to the west lies the extensive wooded ridge of Laurel Hill (site M13). Most of the ridge is privately owned, however, and being considered for development, but the university also owns a large tract at the south end of the ridge (the Parker Tract), as well as a strip along the north end above Morgan Creek (sites M11, M12, and M14 - see the Overview of the Morgan Creek Valley).

Somewhat more secure, to both the east and south lie federal lands within the Jordan Lake floodplain. These lands extend all the way south to Jordan Lake and are unbroken except by one road located nearly a mile and 1/4 south of the Reserve. This tract is leased from the Army Corps of Engineers to the NC Wildlife Commission as gamelands, and located within the Jordan Lake floodplain; it cannot be developed.

In addition to its extent, age, and integrity, several other features combine to make the Reserve one of the most significant natural areas in the Piedmont. Five of the sites discussed in our report are located partly or wholly within the limits of the

Mason Farm Biological Reserve (M14 - M18) and two of these in particular have such unique features that they have been recognized as having state-level significance by the NC Natural Heritage Program. The Big Oak Woods is the largest tract of old-growth forest in the county and also the largest mature tract of bottomland swamp forest remaining in the entire Piedmont of North Carolina (see site M17 for a detailed description). No less unusual, the forested slopes along the western margin of the Reserve occur over a dike of basic igneous rock and contain many uncommon basophilic plant species. The most significant element of this tract is the population of mature southern shagbark hickories, the largest found in the state and perhaps anywhere within the range of this species (see site M16).

The three other natural areas within the Reserve have regional significance within both Orange County and the greater Triangle area. On the bluff located at the northwest corner of the Reserve is located one of only nine communities of catawba rhododendron found in the county (see site M14), while directly opposite this bluff along the north side of Morgan Creek is a small tract of one of the most mature bottomland forests left in the county (see site M15). Less mature but possibly the most important wildlife area in the region, the Morgan Creek Willow Oak Swamp extends southward from the southern and eastern margins of the Reserve, and is the largest expanse of unbroken swampland in the Triangle; it is currently untransected even by sewer or powerlines (see site M18 for a detailed description).

In addition to the forested natural areas, the lands maintained in cultivation add yet another important element to the Reserve's habitat diversity, especially since the traditional agricultural practice of dividing fields by means of hedgerows has not yet given way to the agro-technology involving vast monocultures and gigantic farm machinery. These fields have been present since the mid 18th century and many of our wildlife species have prospered in the field or edge habitats they offer. Sixty-five of the seventy-eight species of butterflies recorded for the entire county occur at Mason Farm, the presence of all but a handful being due to the old-field and edge habitats (no wooded "natural" area within the county is likely to achieve a similar count). The hedgerows also offer wintering habitat for vast numbers of white-throated, song, swamp, fox, and several other species of sparrows, all of which would have been rarely found in the primeval forest. The same is true for abundant cotton rats, voles, cottontail rabbits, and bobwhite quail, all of which are permanent residents of the hedgerows and field edges.

The presence of such a large concentration of prey species attracts, in turn, many raptors and carnivores that are typically quite scarce elsewhere around the region. Sharp-shinned, cooper's, and marsh hawks all winter commonly at Mason Farm, while red-tailed, red-shouldered, and broad-winged hawks nest within the Reserve. Mason Farm is also one of the few places in the Triangle where barred, screech, and great-horned owls can all

be heard calling at the same time. Common mammalian predators include the red and gray foxes, otter, mink, and racoon, but perhaps the most noteworthy resident is the bobcat, an animal whose numbers are dwindling throughout our area and which will require large sanctuaries like Mason Farm if it is to persist.

Altogether, the habitat diversity within the Reserve and adjacent lands make this one of the premier wildlife areas in the Piedmont; it is certainly the best-studied area in terms of its animal populations. The bird community by itself can only be described in terms of superlatives:

The total number of bird species that has been observed at Mason Farm during the approximately fifty years records have been kept is 215 (Hall, Jones-Roe, and Wiley, 1986). This is only one less than for the entire county (only the extremely rare goshawk has not been seen there), and is an incredible number for such a small inland area. Eighty-two of these species are considered breeding birds, as documented by thirteen years of censuses, while seventy-four species have been recorded as wintering at Mason Farm.

Particularly noteworthy are ten of the breeding species found here that are considered regionally-rare in this report. Five of these, in fact, were not observed nesting elsewhere in Orange County during 1988, while at the same time, two of these five, the redstart and prothonotary warblers, occurred in large or substantial numbers at Mason Farm. Perhaps even more impressive, the extremely rare Swainson's warbler has maintained a regular presence of up to six breeding pairs within the Reserve and on the adjacent gamelands.

No less outstanding is the list of 100 species of other vertebrates that has been compiled for the Reserve (Hall et al, 1986). One species, the four-toed salamander (Hemidactylium scutatum), is state-listed as unknown in distribution and an additional 15 are considered regionally rare in this report; six, in fact, were not documented as occurring elsewhere in Orange County. Three species of regionally-rare invertebrates also occur at Mason Farm as do two regionally rare plant species plus one that is state-listed as significantly rare.

Because of its great natural values and the aesthetic qualities of its open fields and dense forests, Mason Farm is one of the three most familiar natural areas in the county (along with the Korstian Division and Eno River State Park). The natural history of the Preserve was made nationally famous through John Terres' From Laurel Hill to Siler's Bog; the Walking Adventures of a Naturalist, and dozens of organized field trips take place at Mason Farm each year, sponsored by such groups as the Audubon Society, Sierra Club, Chapel Hill Bird Club, and NC Botanical Garden.

ORANGE COUNTY NATURAL AREAS SURVEY. SITE DESCRIPTION.

Site name: Mason Farm Pond Rhododendron Slope
Site number: M14

Significance: 2 - Regional Integrity: 1 - Prime
Threat Status: 3 - Moderate

Location: On south side of Morgan Creek just downstream from the Mason Farm Wastewater Treatment Plant.
Approx. acreage: 3

Jurisdiction: NC Botanical Garden

Reasons for significance: This is one of the five rhododendron slopes occurring along Morgan Creek (only nine occur in Orange County), and the only one of these communities that does not have private lands impinging upon its upslope margin. One state-listed plant species occurs here, the significantly rare sweet pinesap (Monotropsis odorata). There are also large populations of three regionally rare animal species associated with the disjunct rhododendron communities: the red-backed salamander (Plethodon cinereus), the sumo mite (Allothrombium sp.), and a rare land snail (Mesomphix sp.). Although this is one of the smaller of the rhododendron bluffs, its inclusion within the Mason Farm Biological Reserve contributes to the overall habitat diversity of this important site for scientific studies.

General description: This is the farthest downstream of the rhododendron communities along Morgan Creek, situated right where the crystalline rock formations typical of the Piedmont give way to the flat sediments of the Triassic Basin. The site is dominated by an impressive outcrop of metamorphic rock, which provides both the acidic soil and steep northern exposure required by Piedmont populations of catawba rhododendron (Rhododendron catawbiense). Other plants occurring here that are found along steep, stream-cut bluffs include wintergreen (Gaultheria procumbens), trailing arbutus (Epigaea repens), and the significantly rare sweet pinesap (Monotropsis odorata). In addition, an uncommon orchid found here is large whorled pogonia (Isotria verticillata).

The canopy above this interesting shrub and herb community is dominated by beech (Fagus grandifolia), red maple (Acer rubrum), and red oak (Quercus rubra), with scattered white oaks (Q. alba), black oaks (Q. velutina), and pignut hickories (Carya glabra). The subcanopy is composed of dogwood (Cornus florida), sourwood (Oxydendrum arboreum), hop hornbeam (Ostrya virginiana), red cedar (Juniperus virginiana), witch hazel (Hamamelis virginiana), and ironwood (Carpinus caroliniana). On the rocky slope above the creek occur wildflowers such as saxifrage (Saxifraga virginiana), toothwort (Cardamine angustata), hepatica (Hepatica americana), aster (Aster divaricatus), and false solomon's seal (Smilacina racemosa). Other herbaceous species are beech drops (Epifagus virginiana), rock cap fern

(Polypodium virginianum), pinesap (Monotropa hypopithys), and two wild gingers (Hexastylis minor and H. arifolia).

Several interesting animal species occur along this bluff, probably due to the same conditions responsible for the presence of the rhododendrons; they are not, however, confined to the same boundaries as the plant community and extend all the way to the bend in Morgan Creek below the wastewater treatment plant. The red-backed salamander is right on the southern limits of its distribution here in the Piedmont and occurs in our area only as widely disjunct populations. In addition to the population found here, this species has only been recorded elsewhere in the county immediately upstream at the King's Mill Rhododendron Slope (M12) and at the ERSP Mountain Spleenwort and Rhododendron Bluffs (E14). Similarly, the sumo mite (Allothrombium sp.) also appears to be a disjunct in our area, occurring only along steep north-facing bluffs and representing a generally northern genus (this species is probably undescribed). Its populations, however, are somewhat more frequent than the salamander's, occurring in conjunction with a few mountain laurel slopes in addition to the other rhododendron communities in the county. One additional and particularly intriguing animal falling into this category is a land snail (Mesomphix sp.). This genus is endemic to the Appalachians and contains several threatened species there; it has not been previously recorded as far east in the Piedmont as Orange County, and the exact identity of the species occurring on this bluff has not yet been established. So far as known, this is the only site in the county where it occurs and thus deserves particular attention.

Other animals typical of stream-cut bluffs include the folding-door spider (Antrodiaetus unicolor) and two species of trap-door spiders (Myrmekiaphila fluviatilis and Ummidia carabivorus). These populations are of historic interest since an early description of their behavior was written by Atkinson (1887) while he was a student at Chapel Hill; indeed, this bluff appears to be the site of his collections and may represent the type locality of Ummidia carabivorus which Atkinson was the first to describe. All three of these spiders appear to be rare elsewhere in the county.

Protection Status: Designated as a protected natural area by Botanical Garden; proposed but not registered with NC Natural Heritage Program.

Surrounding land use:

N: Morgan Creek, Finley Golf Course
E: Forest, Mason Farm Biological Reserve
S: Forest, Mason Farm Biological Reserve
W: Forest

Threats:

Immediate: Development of adjoining private lands uphill.

Potential: The planned Laurel Hill Parkway would transect this area, destroying much of the habitat for the red-backed salamander and the rare land snail.

Recommendations for management or protection: Delete the Laurel Hill Parkway from the Thoroughfare Plan; acquire a buffer strip for the lands next to the private property.

Ownership: See Appendix A

Documentation References: Jones, 1980.

ORANGE COUNTY NATURAL AREAS SURVEY. SITE DESCRIPTION.

Site name: Morgan Creek Hackberry Bottom
Site number: M15

Significance: 4 - County Medium Integrity: 1 - Prime
Threat Status: 4 - Strong

Location: Along north bank of Morgan Creek from Mason Farm Wastewater Treatment Plant to ford at Mason Farm Biological Reserve.

Approx. acreage: 12

Jurisdiction: NC Botanical Garden, Town of Chapel Hill Planning District.

Reasons for Significance: The floodplain along this stretch of Morgan Creek contains one of the oldest stands of alluvial forest in Orange County; particularly noteworthy is the number of large hackberries (Celtis laevigata) that occur here, forming the county's best stand of this species. This strip of riparian forest also provides a scenic entranceway into the Mason Farm Biological Reserve, as well as an important buffer for the Reserve's wildlife and aesthetic values. It is an area well known to the area's birders, many of whom visit it each year, especially during the spring and fall migrations when thousands of migrating warblers and other song birds pass through.

General Description: Although this is a fairly small tract of bottomland, constrained on one side by a steep bluff and on the other by the Finley Golf Course, it has been left largely undisturbed by the University since it was acquired as part of the Mason Bequest in 1894. Its age appears to be roughly comparable to the Big Oak Woods (M17); a large southern red oak (Quercus falcata) that was blown down by the wind was determined to be over 150 years old by a count of its growth rings. Many individual trees have diameters of over two feet.

The composition of the forest is classically typical of alluvial areas along small streams, although now seldom seen in such a complete state. In addition to the hackberries, there are sycamores (Platanus occidentalis), tulip poplars (Liriodendron tulipifera), sweet gums (Liquidambar styraciflua), American elms (Ulmus americanus), river birches (Betula nigra), and boxelders (Acer negundo), individuals of all of which reach great size. Also notable are the large vines of wild grape (Vitus rotundifolia) reaching all the way from the ground to the canopy of the tallest trees. In the understory occur large stands of pawpaw (Asimina triloba) and thickets of spicebush (Lindera benzoin) and bladdernut (Staphylea trifolia). Herbs characterizing this site are May apple (Podophyllum peltatum), jack-in-the-pulpit (Arisaema triphyllum), and especially green dragon (A. dracontium), which thrives here in great numbers.

The large trees, dense thickets, and proximity to the creek make this area quite attractive to many animal species. As mentioned above, this entranceway to the Mason Farm Biological Reserve is one of the best known birding areas in the Triangle, particularly during the migration periods; many of the 101 migrants recorded for Mason Farm were observed in these woods along the creek. Especially worth mentioning are the 23 species of warblers and vireos that have been observed here, as many as for the rest of the county combined. These include the rarely seen Philadelphia Vireo (Vireo philadelphicus), cerulean warbler (Dendroica cerulea), Connecticut warbler (Oporornis agilis), and mourning warbler (O. philadelphia).

Equally noteworthy are the species that choose this small tract for nesting or permanent residence. Prothonotary warblers (Protonotaria citrea) and redstarts (Setophaga ruticilla) regularly nest here, although they are uncommon or absent as breeding species throughout the rest of the county (except at sites downstream within the Mason Farm Preserve). Three species of fish, the bowfin (Amia calva), banded sunfish (Enneacanthus obesus), and flier (Centrarchus macropterus), have all been collected at the Mason Farm ford, and represent species much more typical of the coastal plain. This is their farthest penetration into Orange County, if not the entire Piedmont. The red-bellied watersnake (Nerodia erythrogaster) is similar in this regard (although it has also been found upstream in the NC Botanical Garden). Other notable residents of this riparian forest include the great horned owl (Bubo virginiana), wood duck (Aix sponsa), red-tailed hawk (Buteo jamaicensis), pileated woodpecker (Dryocopus pileatus), and racoon (Procyon lotor), all of which have been observed over a number of years denning, nesting, or roosting in the large trees of this stand. Otter (Lutra canadensis) also make regular visits to this section of Morgan Creek.

Protection Status: Designated as natural area by NC Botanical Garden.

Surrounding land use:

- N: Finley Golf Course
- E: Forest
- S: Morgan Creek, forest
- W: Wastewater Treatment Plant

Threats:

- Immediate:** The Laurel Hill Parkway, as planned, would completely demolish this tract of bottomlands. The golf course currently uses the upstream end as a borrow pit.
- Potential:** Upgrading of existing access road.

Recommendations for management or protection: Delete or re-route Laurel Hill Parkway, so that it does not harm this

natural area or others within the Mason Farm Biological Reserve.

Ownership: See Appendix A

Documentation References: None

ORANGE COUNTY NATURAL AREAS SURVEY. SITE DESCRIPTION.

Site name: Mason Farm Southern Shagbark Hickory Forest
Site number: M16

Significance: 1 - State Integrity: 1 - Prime
Threat Status: Botanical Garden property 3 - Moderate;
private property 1 - Extreme.

Location: Along western slope of the Mason Farm Biological Reserve, from Morgan Creek south onto private lands down to Buck Branch.

Approx. acreage: 250

Jurisdiction: NC Botanical Garden; Town of Chapel Hill Planning District.

Reasons for Significance: This is the largest forested area on diabase rock in the county. The southern shagbark hickories (Carya carolinae-septentrionalis) growing in this tract are particularly numerous and this stand has been recognized by the NC Natural Heritage Program as the best in the state, if not the entire range of this species. One specimen tree was designated in 1988 by the Society of American Foresters as the national champion sized southern shagbark hickory. The golden alexander (Taenidia interrigima), another plant that prefers the relatively basic soils produced by diabase, also has its largest county population in this tract. Five regionally-rare animals observed here are the broad-winged hawk (Buteo platypterus), bobcat (Lynx rufus), Carolina anole (Anolis carolinensis), broad-headed skink (Eumeces laticeps) and the pepper-and-salt skipper butterfly (Amblyscirtes hegon).

General Description: The distinctive features of this site are due to the presence of two long dikes of diabase, running from north of Morgan Creek southward past the county line. These structures occur right at the junction of the crystalline rock formations of the Piedmont and the sediments of the Triassic Basin; they represent linear intrusions of igneous rock that welled up along a fault line created around the time when North America pulled away from Africa some two hundred million years ago, as the Triassic Basin itself was formed by down-slipping. They are commonly associated with the Durham Basin in our area.

The soil weathered from this rock formation is more basic than those more typical of the Piedmont and many plant species grow over these formations that occur nowhere else in the region. At Mason Farm the most distinctive of these is the southern shagbark hickory (Carya carolinae-septentrionalis), whose presence almost always indicates the presence of a basic soil. Due to the protection given this tract since 1894, when the University acquired it as part of the Mason Bequest, the forest has grown to maturity, in contrast with other diabase areas in the county now under

cultivation or covered with houses. The shagbarks are both numerous and quite large, several approaching two feet in diameter. The extent and maturity of this stand of shagbarks combine to make it one of the best examples in the entire southeast, as has been recognized by the NC Natural Heritage Program.

Also characteristic of basic soils is the subcanopy composed of numerous Florida maples (Acer saccahrum ssp. floridanum), redbuds (Cercis canadensis), and red cedars (Juniperus virginiana), and the dense shrub layer made up of viburnums (Viburnum rafinesquianum and V. dentatum). While the herb layer is fairly sparse due to the poor drainage and summer dryness of this site, the golden alexander (Taenidia integerrima) reaches its greatest abundance in the county on a small knoll among numerous boulders of diabase. On the flats below this knob, the flood/drought hardy sphagnum moss (Sphagnum sp.) and greenbrier (Smilax spp.) form extensive patches reminiscent of the situation seen at Meadow Flat, another extensive area of basic soil in Orange County.

One animal possibly also associated with the dry, basic conditions of this tract is the salt-and-pepper skipper (Amblyscirtes hegon), whose host plants are grasses growing in open woodlands, including uniola grass (Uniola latifolia), which often occurs on diabase dikes. This butterfly has been found at only one other site in Orange County, the dry forest on the south slope of Buckwater Ridge (E11); elsewhere it has rarely been recorded for the Piedmont of North Carolina (and is considered threatened in Maryland).

Other animals abound in this forest due both to its own maturity and large size and to its connection to the even more extensive upland woods of Laurel Hill (M13) and bottomland tracts of the Big Oak Woods (M17) and Morgan Creek Swamp (M18). This is the site of the longest-running breeding bird census in the entire Southeast (since 1976), and the average number of bird species nesting within the census plot is 28, second in Orange County only to the Morgan Creek Swamp with 31 species; its average density of nesting pairs is 591/km², second only to the Big Oak Woods with 667/km².

The presence of several resident species of raptors is especially noteworthy, since all require large tracts of forest relatively free from human disturbance. These include the broad-winged hawk (Buteo platypterus), which is a montane bird rarely breeding now in the Piedmont, the red-shouldered hawk (B. lineatus), a bird requiring extensive areas of bottomlands for feeding, the red-tailed hawk (B. jamaicensis), screech owl (Otus asio), great horned owl (Bubo virginianis), and barred owl (Stryx varia). In winter the number of raptors increases with the addition of numerous sharp-shinned and cooper's hawks (Accipiter striatus and A. cooperi). There is also at least one report suggesting that sharp-shins may breed here, a very rare occurrence in today's Piedmont.

Other notable species are the bobcat (Lynx rufus), which has been frequently seen here but rarely elsewhere in the

county, and the broad-headed skink (Eumeces laticeps), which maintains a colony on the old caretaker's cabin next to these woods but which was not recorded for any other site in this survey. The 28 species of butterflies documented for this forest is quite unusual for a woodland habitat in our area.

Protection Status: Designated by Botanical Garden as protected natural area, but not registered with the NC Natural Heritage Program as has been proposed.

Surrounding land use:

N: Morgan Creek
E: Agriculture, forest
S: Forest
W: Forest

Threats:

Immediate: Development of private lands within and adjoining the natural area.

Potential: Same plus timbering and the possible re-routing of Laurel Hill Parkway.

Recommendations for management or protection: Maintain its current designation as a protected natural area and register the site with the NC Natural Heritage Program, as has been proposed; acquire a buffer strip upslope, especially along Yancey Brook and other watersheds feeding into The Mason Farm Biological Reserve.

Ownership: See Appendix A

Documentation References: Wiley, 1976; Hall and Wiley, 1977; Root, 1977; Hall and Mueller, 1978, 1979, 1980, 1981, 1982, 1983, 1984; Howard, 1984.

ORANGE COUNTY NATURAL AREAS SURVEY. SITE DESCRIPTION.

Site name: Big Oak Woods
Site number: M17

Significance: 1 - State Integrity: 1 - Prime
Threat Status: 4 - Slight

Location: Central wooded portion of the Mason Farm Biological Reserve.

Approx. acreage: 40

Jurisdiction: NC Botanical Garden; within US Army Corps of Engineers flood easement for Jordan Lake.

Reasons for Significance: This is the largest tract of old-growth forest in the county, and probably the largest in the entire Triangle. It is certainly the largest tract of mature bottomland swamp forest remaining in the Piedmont and has been recognized as having state-level significance by the NC Natural Heritage Program. The breeding density of birds is the highest in the county, reflecting the prime conditions present in this mature bottomland forest.

General Description: Growing on a wide expanse of rich Chewacla soil and protected by the University since 1894, the Big Oak Woods is one of the most magnificent tracts of forest remaining in the region. The many stately willow oaks (Quercus phellos), swamp chestnut oaks (Q. michauxii), cherrybark oaks (Q. falcata var. pagodaefolia), Shumard's oaks (Q. shumardii), overcup oaks (Q. lyrata), and northern shagbark hickories (Carya ovata) illustrate the classical composition of a mature bottomland forest, seldom seen today given the intense cutting that has taken place over the past 250 years. The wide spacing and large size of these trees, several of which approach three feet in diameter, give this forest a cathedral-like atmosphere, while great masses of atamasco and trout lilies (Zephyranthes atamasco and Erythronium americanum), toothworts (Cardamine bulbosa), and spring beauties (Claytonia virginica) carpet the forest floor in the spring.

Along with the other tracts of the Mason Farm Biological Reserve, this is one of the best-known birding areas in the Piedmont. Due to its complex canopy stratification, the Big Oak Woods is especially outstanding with regard to the densities recorded for its breeding birds. Over an eight-year period, the number of breeding pairs averaged 667/km², the highest for any site in the North Carolina Piedmont. Its average number of 27 species is also impressive, reflecting the presence of several species typical of bottomland forests in addition to the more widespread birds of the Piedmont. The black-and-white warbler (Mniotilta varia), which occurs only sparsely in the Piedmont, has been recorded here several times during the breeding season. More regular and abundant are the hooded (Wilsonia citrina) and Kentucky warblers

(Oporornis formosus), both of which nest either on the ground or close to it, and thus require large tracts of undisturbed forest for breeding; together with the adjoining Mason Farm Shagbark Forest and Morgan Creek Swamp, 30 pairs of hooded warblers and 15 pairs of Kentucky warblers were recorded for this area in 1988 alone (R.H. Wiley, pers. comm.), an extremely impressive number when compared to their sparse occurrence in the rest of the county. Also present as breeding species are the redstart (Setophaga ruticilla), northern waterthrush (Seiurus motacilla), parula (Parula americana), yellow-throated (Dendroica dominica) and prothonotary warblers (Protonaria citrea), all species characteristic of bottomland forests, as are the red-shouldered hawk (Buteo lineatus), barred owl (Stryx varia), wood duck (Aix sponsa), and woodcock (Philohela minor), which also nest here regularly.

Equally typical of bottomland forests are mammals such as the southeastern shrew (Sorex longirostris), golden mouse (Ochrotomys nuttalli), and the regionally-rare marsh rabbit (Sylvilagus palustris), which only occurs in Orange County here and in the Morgan Creek Swamp (the only other Piedmont record is for the nearby New Hope Swamp). Two large vernal pools, together with several smaller ones provide important breeding habitat for several species of amphibians, including the marbled salamander (Ambystoma opacum) and spotted salamander (A. maculatum), both of which require such isolated, long-lasting, and fish-free pools for their larval development. In addition to the vertebrates, 21 species of butterflies have been recorded here, including the zebra swallowtail (Eurytides marcellus), whose host plant is the pawpaw, and other bottomland species such as appalachian eyed brown (Satyrodes appalachia), large wood nymph (Cercyonis pegala) and zabulon skipper (Poanes zabulon).

Protection Status: Designated as protected natural area by NC Botanical Garden, but not registered with NC Natural Heritage Program as has been proposed.

Surrounding land use:

- N: Agriculture
- E: Forest, gamelands
- S: Forest, gamelands
- W: Forest

Threats:

Immediate: None known.

Potential: The entire natural area lies in the upper end of the 100 year floodplain of Jordan Lake.

Recommendations for management or protection: Maintain the current designation as a protected natural area; register the site with the NC Natural Heritage Program.

Ownership: See Appendix A

Documentation References: Hall and Wiley, 1977; Hall and Mueller, 1978, 1979, 1980, 1981, 1982, 1983, 1984.

ORANGE COUNTY NATURAL AREAS SURVEY. SITE DESCRIPTION.

Site name: Morgan Creek Swamp

Site number: M18

Significance: 2 - Regional

Integrity: 4 - Moderately Good

Threat Status: 4 - Slight

Location: Jordan Lake floodplain along Morgan Creek south and east of the Mason Farm Biological Reserve (Morgan Creek Gamelands).

Approx. acreage: 35 (just the Orange County portion of a much larger tract).

Jurisdiction: US Army Corps of Engineers; NC Wildlife Commission; Town of Chapel Hill Planning District; Durham and Chatham Counties.

Reasons for Significance: This site forms part of one of the largest and least broken tracts of swamp forest remaining in the Piedmont. Except for one secondary road, it extends undivided for over two miles from the Mason Farm Biological Reserve to Jordan Lake (the New Hope Swamp, in contrast, is transected by several major highways as well as many sewer and powerlines). Along the southern border of Mason Farm the swamp is over 3/4 of a mile wide.

Several animal species occur here that are far more typical of the coastal plain than the Piedmont, reaching their westernmost limit in these broad lowlands of the Triassic Basin. Most notable of these are the Swainson's warbler (Limnothlypis swainsonii) and marsh rabbit (Sylvilagus palustris), both of which are nearly unknown as breeding species in the Piedmont. One important Piedmont species that also breeds here is the four-toed salamander (Hemidactylium scutatum), which is state-listed as unknown in distribution.

General Description: Although far younger than many forests in the county (some sections having been cut within the last 15 years), the Morgan Creek Willow Oak Swamp is far more extensive in unbroken area than most others in the Piedmont; given protection as part of the Jordan Lake floodplain, it could develop into one of the Triangle's premier forests. Even now it contains a forest type that is rare within the county, the alluvial terrace woodlands found only along the widest floodplains. The dominant species here are sycamore (Platanus occidentalis), boxelder (Acer negundo), sweetgum (Liquidambar styraciflua), tulip poplar (Liriodendron tulipifera), and bitternut hickory (Carya cordiformis), a composition different from the Big Oak Woods, which has a different sort of flooding regime. A dense shrub layer of privet (Ligustrum sinense), an introduced species, is almost impenetrable in places, providing shelter for many species of wildlife.

The animal species, indeed, are this tract's most

significant feature. An average of 31 species of breeding birds have been censused on a 20 hectare study site within this tract, a higher number than any other site in Orange County, including the Big Oak Woods (although only two years worth of data have been collected thus far; R. H. Wiley, pers. comm.). The average density of nesting territories at 559/km². Although this is much lower than for the Big Oak Woods, but comparable to the Mason Farm Shagbark Forest, it is remarkable that 16 per cent of this density (92/km²) is made up of the territories of redstarts (Setophaga ruticilla). This species is virtually unknown as a breeding species in the county outside the Mason Farm area. Prothonotary warblers (Protonaria citrea) also occur here in higher density than elsewhere (10/km²), but perhaps the most noteworthy breeding bird is the Swainson's warbler (Limnithlypis swainsonii). Its density here is very slight (only a maximum of 6 territories have been observed within the entire swamp) but significant since this bird so rarely breeds within the Piedmont at all. Other bottomland birds regularly nesting in this forest include the parula (Parula americana), hooded (Wilsonia citrina) and Kentucky warblers (Oporornis formosus), as well as the hairy (Picoides villosus) and pileated woodpeckers (Dryocopus pileatus), barred owl (Stryx varia), and red-shouldered hawk (Buteo lineatus), four territories of the last and least common species having been observed within the swamp.

In addition to the avifauna, 52 other animals have been documented for the swamp, including the regionally-rare bobcat (Lynx rufus), otter (Lutra canadensis), mink (Mustela vison), and marsh rabbit (Sylvilagus palustris), which occurs nowhere else in the county apart from the adjacent Big Oak Woods (and nowhere else in the Piedmont of North Carolina except for the nearby New Hope Swamp). Seven species of typical coastal plain fish have been collected here, several of which have not previously been documented above the fall line. Finally, one state-listed species, the four-toed salamander (Hemidactylium scutatum), was discovered this year nesting in a pool located at the northern end of the swamp within the Mason Farm Biological Reserve.

Protection Status: NC Gamelands; Jordan Lake 100 year floodplain

Surrounding land use:

N: Forest
E: Forest, agriculture
S: Jordan Lake
W: Forest, agriculture

Threats:

Immediate: None known
Potential: Timbering; flooding; construction of roads, powerlines, sewerlines, and subimpoundments.

Recommendations for management or protection: Maintain in its

unbroken state; cease timbering to allow forest to mature.

Ownership: See Appendix A

Documentation References: Wiley, 1986, 1988.

Suggested Wildlife Corridor System.

In this report we have identified 64 natural areas in Orange County which have important plant or animal communities. These sites represent the best of what is left of the natural landscape which is rapidly changing in this part of North Carolina. In this appendix we would like to review some current ideas from the field of conservation biology. Then, from these ideas and our own field experience in Orange County, we will make some recommendations for a greenway system and a wildlife corridor system that will serve the needs of public recreation and preservation of plant and animal wildlife.

Introduction.

For roughly 300 years, the presettlement landscape of Orange County has been fragmented by humans. From early settlement to the early 20th century, clearing for agriculture and timber was the major disturbance. With the post-Depression relaxation of farming, many features of the original landscape returned as old fields grew back into forests. But recently a dramatic increase in non-farm residential construction has been spurred by rapid economic growth and increased highway construction. At a rapid pace, the landscape is changing from a pastoral matrix of farms and woods to a suburban network of subdivisions named after the natural features they replace.

Concern for the vanishing natural landscape has grown in recent years, and segments of both the public and scientific communities are seeking strategies to preserve diversity. Preservation dollars and biological research have generally been directed toward large areas such as national parks and regional preserves. On a smaller scale, tracts of unique or outstanding natural features have been the focus of state Natural Heritage programs and The Nature Conservancy. The more parochial focus of maintaining biotic diversity on the local (i.e. county) level has received little attention in the biological literature or from the county planning boards across the country. Yet the county level is important for several reasons. It is the unit of landscape with which most people identify on a daily basis. It is also the unit of political power which makes decisions about zoning and land use that affect further development and fragmentation. Preservation on the county level may prove difficult. Mega-vistas and expansive natural areas are often lacking, so there is less to rally public sentiment for preservation. Public concerns about land-use legislation are higher when decisions may affect property rights and limit land utilization.

In our survey of Orange County's natural areas we have given special attention to identifying areas of wildlife habitat. In natural area conservation, primary emphasis is often given to the preservation of plant communities in determining which habitats are worthy of preservation. Animals, it is argued, are dependent on the plant communities and will be retained only if the requisite plants are conserved first. While this certainly has an element of truth, it does not follow that the needs of the animal populations are identical to those of the plants. Indeed, the survival of the faunal representatives of a community depends on factors that are often of far less importance for the flora.

For a number of reasons, animal populations are more vulnerable to habitat fragmentation than plants, and the major problem in conserving native animal species involves the avoidance of isolation, that is, the maintenance of connections to other populations. Whereas a plant community can persist for decades or even centuries in a relatively small park completely cut off from other such communities, the aboriginal fauna of the site will gradually dwindle and be replaced with species more adapted to disturbed environments.

The basic reason for this difference is that animals have greater spatial requirements than plants. They must move around in order to find food, mates, and shelter, whereas plants are sessile organisms (with mobile propagules) which can remain at one site. Further complicating animals' need for space is that they often have more complex habitat requirements than plants. For instance, they may utilize completely different habitats for foraging and shelter, for normal ranging and nesting, or for juvenile and adult life history strategies. Still more space is needed when territoriality is employed by individuals to secure not only their immediate requisites for existence or reproduction but their future needs as well; animals frequently exist in numbers well below the actual carrying capacity of the environment, while plant populations are often at full load.

Animals usually exist in smaller numbers (or biomass) than plants within a given area, especially when species at the top of the food chain are considered: there are far fewer deer in a forest than oak trees, and just a fraction of top carnivores compared to herbivores. Compounding this difference, the minimum viable population sizes for animals are generally larger than for plants. Extinction is more likely for animal populations of small size than for a similar small population of plants. This follows from the usually shorter life spans of animals and their general lack of asexual reproduction. Whereas many perennial plants can

survive in one spot year after year or form new individuals by vegetative growth, animal populations are usually in a constant state of flux, with much turnover between years either due to emigration and immigration or transition between generations. Animals such as the box turtle that depend on longevity and sustained individual reproductive effort in order to keep the population going are relatively few compared to the number of plant species that employ this strategy.

One final and perhaps most crucial difference between plants and animals with regard to their preservation within a human-dominated landscape is that animals are sensitive to a much greater range of disturbances than are plants; the behavioral disruptions among animals brought on by human proximity simply have no counterpart among plants. For example, the construction of a road or path through a forest or the development of an residential area or mall adjacent to a natural area will have little immediate effect on the vegetation, at least away from the newly created edge, but the effect on the fauna may be profound and far reaching, especially for the larger and warier species that have historically fared poorly at the hands of man. Not only will this sort of disturbance induce many animals to emigrate, but those that stay may suffer a decline in reproduction or other deleterious effects brought on by stress.

Recent shifts in ecological thought have begun to establish the importance of natural disturbance in the maintenance of species and communities. The earlier 20th century idea of broad homogeneous expanses of forest, the "climax community" sensu Clements, is being replaced with the idea that the landscape is essentially heterogenous, composed of patches responding to natural disturbances such as windstorms, gaps created by the removal of canopy trees, and fire. We do not yet understand the disturbance regime for the Piedmont of the eastern U.S. as well as we do that of the nearby Southern Appalachian Forest (Runkle 1985), so we cannot be sure at what frequency or intensity these disturbances shifted across the region. But we can be sure that at some time all parts of the landscape were disturbed, and the species composition of communities was altered. The common occurrence that we witness today of a large mature tree toppled by the wind has been repeated through time. When such an opening is created, other species better adapted to take advantage of the sudden influx of light move in, as do other species that can utilize the fresh mound of earth upturned by the downed tree's root system. Across the presettlement landscape, disturbances such as these served to maintain the diversity of species in the large area by opening these different stages of habitat; there was plenty of room for all stages of disturbance. In today's fragmented

landscape these natural processes of disturbance continue, but smaller isolated tracts may be severely affected to the point where species go locally extinct. This scenario and its implications for preserve design and management will be considered below.

Disturbances caused by man are more pervasive and often more permanent. Most common among these anthropogenic disturbances are agriculture, livestock husbandry, timbering, construction of powerlines, phone cables, and sewerlines, road construction and residential building. The scale and effect of these disturbances can vary. Agriculture can impact large acreages with unbroken fields, or can be broken up with borders or hedgerows to facilitate a more diverse assemblage of species. Grazing animals can have a serious effect on vegetation and soil erosion. Timber practices can range from slowly recovering clearcuts which increase erosion to minimal-impact selective harvesting. Utility corridors often shoot in straight lines across the countryside, with little regard for natural features, while sewer lines follow stream corridors, opening these forest canopies to light and numerous changes. Roads can have the same effects as utility corridors, and their impact as barriers to animal movement is often related to their size and traffic load. They create edges for invasion, as well as allowing easier human access for further disturbance. Residential construction introduces more clearings, and is often accompanied by the introduction of exotic plant species and dogs and cats which can affect wildlife (Wilcove et al. 1986). All of these terrestrial disturbances have a detrimental effect upon natural stream systems, by contributing to erosion and subsequent lowering of the water quality required by some stream-dwelling species. Also, the increase in impervious surfaces and decrease in forested acres results in less ground water retention and more rapid water discharge into streams.

These anthropogenic disturbances are but a partial list; to maintain any sense of optimism in this discussion we will consider only these site-specific impacts of humans and not the larger issues such as global release of toxins and alteration of climate. Landscape fragmentation and modification is largely a function of human population density, and as Orange County grows we can expect these pressures to increase. Wildlife will shift; species not adaptable to forest edges will move to sites where forest interiors still exist.

Elements of natural diversity in Orange County.

What do we have, and what do we want to keep? To answer this we must inventory, rank, and assign priorities to the