

## BIOGEOGRAPHIC FEATURES OF CHATHAM COUNTY

As can be seen in Figure 1, most of the natural areas identified in this survey are concentrated in just a few parts of the county. This geographic pattern is no accident and can be understood by considering the association between these sites and particular geological features, local variations in climate, and especially the distribution of the county's human population. This section provides a brief overview of the major biogeographic features of the county and introduces terms and concepts that will be used later in describing the individual sites.

### TOPOGRAPHY

As mentioned in the section on Methods, topographic maps provide some of the most important initial information for the identification of prospective natural areas. Landform itself is a major determiner of the makeup of biological communities, particularly where it interacts with other factors, such as rocks, soils, and microclimate. Topography also plays a major role in determining patterns of human settlement and exploitation of natural resources. That, in turn, has had perhaps the dominant role in determining where high quality natural areas may still be found.

Chatham County is situated on the eastern edge of the Piedmont Physiographic Province. The Fall Line dividing the Piedmont from the Coastal Plain lies only a few miles east of the county border, being most visible at Raven Rock State Park located on the Cape Fear River in Harnett County. Westward, the Piedmont extends to the Blue Ridge, sloping generally upward from southeast to northwest. Most of the landscape of this region consists of gently rolling terrain, broken occasionally by v-shaped river valleys and by scattered monadnocks -- steep, isolated hills rising sharply above the surrounding terrain (the best known examples in North Carolina include Crowder's Mountain, Pilot Mountain, and Hanging Rock).

This general description of the Piedmont Province is mirrored in the topographic features of Chatham County. The highest terrain occurs in the northwest where much of the land lies above 600 ft in elevation. The highest points in the county are also found in this region: two hills located near the Alamance County line north of Silk Hope stand at 760' and 774'. The lowest elevation, conversely, is found at the extreme southeast corner of the county, where the Cape Fear River makes its exit downstream from Buckhorn Dam; the elevation at this point lies below 150 ft. This general drop in elevation from northwest to southeast is well illustrated by the course of two of the rivers that run through the county, the Haw and the Rocky Rivers. Sharply departing from this elevational trend, however, are scattered monadnocks such as Collins, Terrells, and Edwards Mountains, all located in the north-central and northeast part of the county.

With the exception of the monadnocks and river valleys, the prevailing landscape of the county, again like most of the Piedmont, consists of gently rolling hills. The general absence

of natural areas in most of the central and western part of the county can be explained by the fact that such terrain is eminently suitable for agriculture. This region of Chatham County has been continuously occupied since the middle of the 18th Century, and apart from isolated woodlots, little room has been left for the wildlife and their habitats.

**RIVERS AND VALLEYS.** The natural areas that do occur in this part of the county (Figure 2) are mostly located within the valleys of the Haw and Rocky Rivers or in the ravines and stream valleys of their tributaries. This distribution is partly accounted for by the fact that the steep slopes and wet bottomlands along these streams have historically escaped cultivation and most other human uses except for occasional timbering. Equally important, the more varied topography of the ravines and river valleys favors the occurrence of natural communities that differ from those prevailing over the majority of the county. For example, the plants and animals living on steep, north-facing river bluffs or ravine slopes tend to show strong affinities to communities more typical of the Blue Ridge than the Piedmont. Conversely, organisms found on south-facing slopes often show more southerly or Coastal Plain affinities. In either case, these communities are fairly restricted in their distribution and often contain species that are quite rare within the region as a whole. This will be discussed in greater detail under the section on climate.

The rich soils, moist conditions, and constant water supply also make the riparian communities some of the richest habitats in the area. Bottomland communities, in general, contain far more species of plants and animals than do the drier uplands. Thirty to forty species of birds can be expected to nest in bottomland and riparian forests, for example, compared to only fifteen to twenty-five on upland ridges. Furthermore, even animals that normally inhabit the hills frequently come down the bottomlands for water, adding yet greater significance to riparian habitats.

While all the factors just mentioned contribute to the importance of these sites, it is the presence of rare species of aquatic animals that raises several of them to state or even national level significance. Again topography plays a major role in explaining the prominence of these aquatic communities.

Situated at the confluence of the Haw and the Deep Rivers, Chatham contains branches of two of the most important rivers in the Piedmont, and gives birth to the Cape Fear River, itself one of the most important streams in the entire state. In addition to these major rivers, the county is also drained by the Rocky River, a smaller stream but one whose basin lies almost completely within Chatham County. Chatham thus possesses a wealth of riverine habitats, including deep water pools, extensive riffles, islands, and levees, all of which are found only along larger streams. While not exactly rare, these habitats are restricted in their distribution in the state as a whole and represented in most counties to a far lesser extent than in Chatham.

Unlike the case of most terrestrial species of the Piedmont, which have no major geographic barriers to their dispersal throughout the entire Atlantic Slope of North America, the aquatic

Figure 1. Distribution of Chatham County Natural Areas

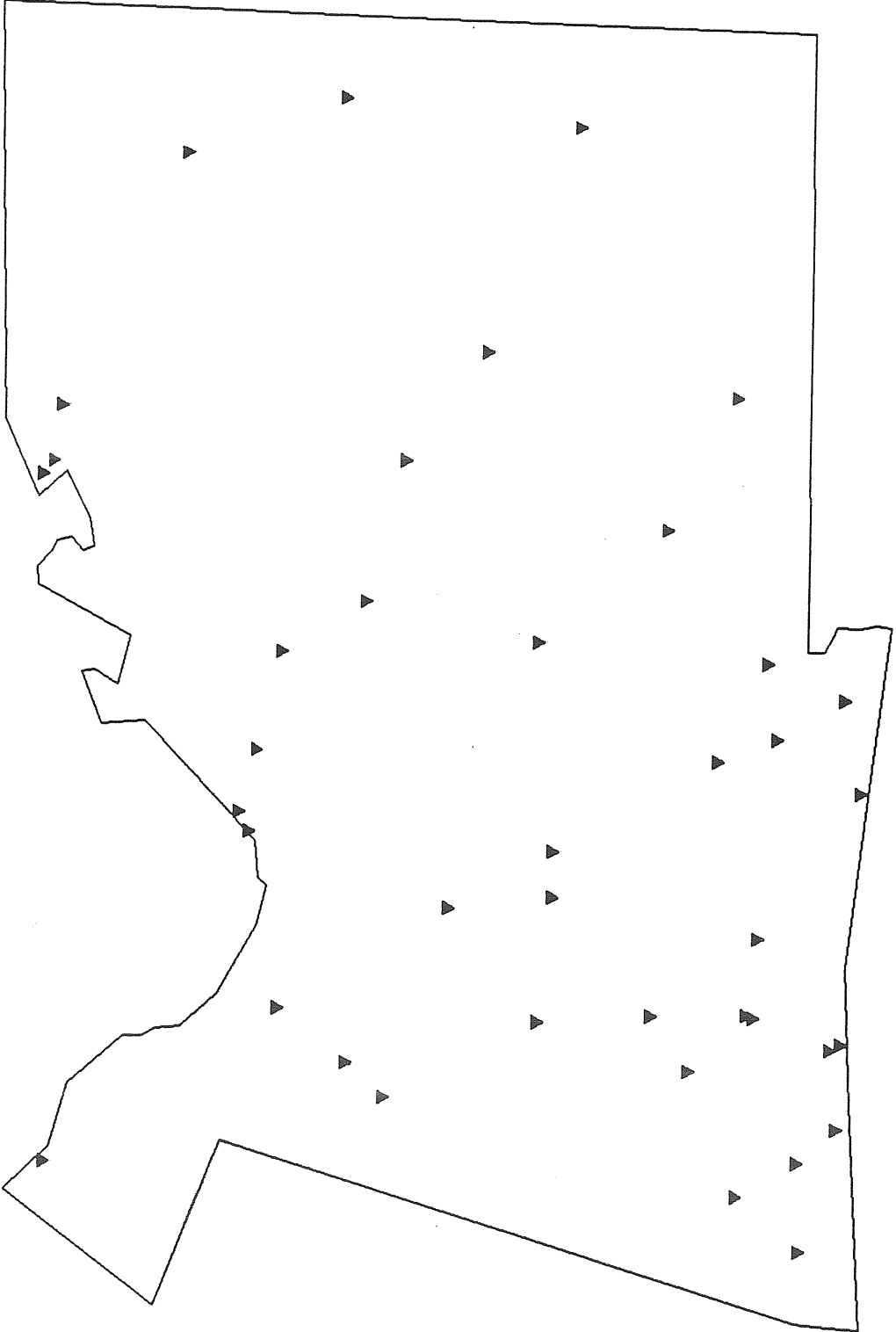


Figure 2. River and Valley Habitats



species inhabiting the rivers within this region occur in isolated populations. For the most part, the rivers of the Atlantic Slope empty separately into the sea and form a ladder-like arrangement of drainage basins all the way from Florida to New Brunswick. For completely aquatic species, such as fish, mollusks, and a few amphibians, dispersal between river basins takes place extremely seldom, primarily by means of stream capture. As a result of this long isolation, many species have evolved into completely new forms unique to particular river systems. One well-known example is the Cape Fear shiner, a minnow found nowhere else on earth but the vicinity of the Fall Line in Chatham, Lee, Johnston, Harnett, and Moore Counties.

While the isolated, island-like nature of Atlantic Slope river habitats is responsible for some of the diversity of aquatic species within this region, it also makes their populations vulnerable to local extinction. This is particularly true today, when human activities have further fragmented and reduced the habitat available for river species. Dams emplaced on virtually all the state's rivers are impenetrable barriers to most fish and mollusks and have effectively chopped up formerly large populations into smaller units, each possessing a reduced ability to survive environmental disruptions, both natural and man-made. No less important are the barriers created by pollution. Vast reaches of our rivers have become uninhabitable except by the most hardy species. Due to their passage through the industrial heartland of the state, the Haw, Deep, and Cape Fear have been particularly hard hit, and most of their aquatic habitats have been degraded for decades. A number of their once most characteristic organisms have now vanished, most conspicuously the beds of freshwater mussels that were once a key element in the rivers' foodchains.

Although absent from the larger rivers, some of the most significant species of the Cape Fear Basin still maintain a precarious foothold in the Rocky River and its tributary, Bear Creek. As will be discussed below under the section on Rare Species, the Rocky contains not only the largest population left on earth of the Cape Fear shiner, but also of an extremely rare dragonfly. Several species of mussels have also managed to persist in this stream, although they have vanished from most of the rest of their range in the state.

Unlike the major rivers, the Rocky is almost completely contained within Chatham County. Its headwaters are located near Liberty, just across the Randolph County line. Through most of its length, it passes through a rural, wooded landscape, with only Liberty and Siler City discharging their municipal wastes into its waters. Until recently, this rural setting protected this watershed, allowing it to keep a rich fauna of fish, mussels, and other aquatic animals. Now, however, the increasing urbanization around Siler City threatens this once pristine stream. At least two species of mussels have now been lost and even the large population of the Cape Fear shiner is threatened. Although the shiner and several of the mussels once occurred as far upstream as the US 64 bridge, most of the remaining sensitive species are now only found downstream from the hydro plant near US 15-501.

**THE TRIASSIC BASIN.** Important aquatic and wetland habitats are not restricted to the steep and rocky river valleys in the center of the county. Another large cluster of the natural

Figure 3. Triassic Basin Lowlands and Escarpment Ravines





generates the strong stream-cutting action responsible for the many highly scenic ravines that have been incised along this edge. The ravines of Herndon and Old Quarry Creek are particularly noteworthy examples. The fact that the escarpment of the Durham Basin runs almost due north to south in this area adds to the natural history significance of these ravines, since the walls of the adjoining ravines running perpendicular to the escarpment have steep north and south-facing slopes. Many of the most mesic (moist) and most xeric (dry) slopes in the county are located along this rim.

More characteristic of the Triassic Basin itself, however, are its extensive areas of wetlands, which include the largest such tracts in North Carolina west of the Fall Line. Even though in Chatham County thousands of acres of the basin have been submerged beneath Jordan Lake, significant areas still occur along Morgan Creek, New Hope Creek, and Northeast Creek at the northern end of the reservoir, providing habitat for such typical Coastal Plain species as flier sunfish, bowfin, Carolina anoles, and red-bellied watersnakes. Equally important, if not more so, these bottomlands contain some of the largest blocks of continuous forest remaining in the entire Triangle Region. They are thus of prime importance to the areas' wildlife, particularly for such wary and wide-ranging species as bobcat, otter, mink, wild turkey, barred owl and red-shouldered hawk.

UPLANDS. At the opposite extreme from the Triassic Basin or the riparian areas of the major streams are the natural areas found in the upland parts of the county. Four of these sites also contain wetlands as their dominant feature (Figure 4), but in contrast to those described above, these take the form of isolated pools and bogs and contain communities that are often quite distinct from those of the riparian areas. One of their major features is that their pools usually dry up completely during the summer and only fill again during the winter. Organisms that are associated with these vernal pools must consequently be highly adapted to extreme shifts in moisture. Characteristic species of such sites include many kinds of amphibians, including spotted and marbled salamanders and the rare four-toed salamander, all of which need fish-free pools for breeding.

More typical of the uplands are sites dominated by dry forest habitats. As shown in Figure 5, these sites are also concentrated in just a few areas of the county where cultivation has been abandoned or never practiced primarily because the sites were too rocky, dry, or rugged to be profitable.

One cluster of these sites, located along the northern border of the county, includes the series of monadnocks mentioned earlier, Collins Mountain, Terrells Mountain, and Edwards Ridge. Each of these hills represents a mass of resistant rock, igneous in origin (either volcanic or plutonic), that has withstood the erosional forces that have worn down the surrounding countryside. A few other smaller monadnocks are scattered throughout the county, including Boothe Hill, Round Top Mountain, Hinson Hill, and the unnamed summit located north of Silk Hope.



Other regions of particularly rugged terrain occur adjacent to the steep escarpment of the Triassic Basin, as in the case of the Big Woods, or next to the Haw River Valley, as in the Pittsboro Firetower Wilderness. The strong stream-cutting action in these areas accounts for their highly dissected terrain, which would otherwise possess the more rolling, plateau-like topography found over most of the county.

For the most part, these drier upland sites are far less diverse in terms of species than are the stream-valleys and bottomlands of the Triassic Basin. Virtually no rare species were observed in these sites, although several of their community types are uncommon, particularly Piedmont Monadnock Forest (see the section on Natural Communities below). On the other hand, they are usually of great value to the area's wildlife, particularly tracts like the Big Woods which are still vast enough to offer room for widest-ranging of the area's wildlife, including bobcat, wild turkey, pileated woodpecker, hairy woodpecker, cooper's hawk, and broad-winged hawk.

### ROCKS AND SOILS

Topography is not the only geological feature shaping the natural communities of the county. Another major factor is the underlying rock formations and the soils that weather from them. Plant communities, as well as certain animal groups like mollusks, are directly influenced by soil chemistry, drainage, and texture. Many of the county's rarer community types, in fact, are restricted primarily because of their association with uncommon rock and soil formations.

The vast majority of the county lies within the Carolina Slate Belt. This is a series of rock formations that are igneous or metamorphic in nature, representing an ancient arc of island volcanoes and adjoining marine sediments that were crushed and uplifted when the North American and African crustal plates collided during the Paleozoic, approximately 300 million years ago. Rocks making up this belt are all crystalline in structure but otherwise highly diverse. As implied by its name, The Slate Belt is composed primarily of metamorphic rocks, including not only slates themselves, but also more lightly metamorphosed igneous and sedimentary rocks such as greywackes (muddy sandstone), conglomerates, and schists (metamorphosed igneous formations). Also prominent are igneous rocks showing little metamorphosis. Rhyolite, tuffs, and other materials ejected from volcanoes are quite common. Other areas are dominated by plutonic rocks, also igneous in origin but representing intrusions of magma that did not erupt onto the earth's surface. The most prominent plutonic formation in Chatham County is the large granitic area centered around Edwards Ridge and Boothe Hill.

Rocks of the Slate Belt are typically acidic and relatively poor in nutrients, as are the soils that weather from them. This is particularly true of the felsic igneous formations, i.e., those that are rich in silica and made up of such minerals as quartz, feldspars, and other light-colored materials. Areas dominated by these formations include the granitic area in the northeast corner of the county as well as areas near old volcanic cores such as Terrells Mountain and Paul Beck Mountain.

Figure 4. Upland Pools and Bogs





Figure 5. Upland Forests





Given the prevalence of Slate Belt series and similar rock formations further west, the vegetation growing on felsic sites is typical for most of the Piedmont. In a few felsic areas, however, the acidity is higher or the nutrients lower than usual. The natural communities found in such areas are often strikingly different from the norm, prime examples being the blueberry and huckleberry dominated sites at the Old Railroad Heath Glades and the Shaddox Creek Felsic Glades and Bottoms.

Other rock formations in the Slate Belt are more basic in pH and richer in nutrients. Some of the metamorphic rocks fall into this category, depending on their parent material. More important however, are mafic igneous formations, i.e., rocks that are formed from magma that is rich in iron, manganese and other metals and composed of such minerals as olivines, peroxenes, amphiboles. A few flows of basaltic lava occur in the county, representing the extrusive form of this rock type. Far more widespread, however, although covering only a small area overall, are diabase intrusions. Diabase has the same chemical makeup of basalt but is coarser in texture, and it forms beneath the earth's surface from magma welling up along fault-lines, rather than as flows spewed out from volcanic vents. Most of the diabase in the county occurs as long linear structures known as dikes, marking the location of ancient faults that resulted from the pulling apart of Africa and North America. Along the Deep River near Gulf, there is also a series of diabase sills, where the magma flowed laterally through subterranean, horizontal faults.

The vegetation growing on the soils weathered from mafic rock formations is typically rich in species, often including plants that are found nowhere else in the region. Many plants, in fact, are excellent indicators of the presence of mafic rocks even where there are no obvious outcrops. Foremost among the trees and shrubs indicating basic to circumneutral soils are southern shagbark hickory, Florida maple, red cedar, winged elm, and redbud.

On flat, poorly-drained topography, on the other hand, the minerals weathered from mafic rocks often form an impenetrable clay (montmorillonite) layer known as a hardpan. In such areas, extremes in moisture -- flooding in winter and drying-out completely in summer -- play a more important role in determining the vegetation than does the presence of nutrients. These sites also possess an unusual vegetation, but one that is far more depauperate than those on more sloping mafic sites or even on some of the nutrient-poor soils of the felsic areas. In some cases, the entire vegetation of these sites may be composed only of willow oaks, greenbriers, and sphagnum moss. On the other hand, they may be particularly rich in breeding amphibians, many of which require fish-free ponds for their larval development.

The other main type of rock formation occurring in the county is sedimentary in origin and is found only within the Triassic Basin. As mentioned above, this trough became filled with freshwater deposits following the separation of Africa and North America, and although uplifted subsequently, this material has not been exposed to the same compressional forces that created the crystalline rocks of the Slate Belt. Much of the sediments, in fact, have remained unconsolidated, although outcrops of sandstones and siltstones are common features

of the basin and underlie the low hills found in this area. The coal fields found along the Deep River also represent sedimentary formations of the Triassic Basin.

The deepest soils in the county also occur in the Triassic Basin bottomlands, where they have been washed for millions of years off the adjacent uplands. The deepest bottomland soil series such as Congaree are virtually restricted to the basin, although similar types, such as Chewacla, are found elsewhere in the county wherever the river floodplains are wide enough to allow deep accumulations of sediments. These soils are not only deep, but also fine in texture and rich in organic materials and minerals. As in the case of the mafic areas, the vegetation growing on these rich soils is usually highly diverse, luxuriant, and again possessing species found nowhere else in the county.

### CLIMATE

On a regional to continental scale, climate is the main abiotic factor shaping biogeography. Although influenced by topography, particularly elevation, variations in moisture and temperature directly determine what sort of biome an area will support, for example, grasslands, desert scrub, tundra, or forest. The cool winters, hot, humid summers, and evenly-distributed rainfall of Chatham County all produce a natural vegetation dominated by hardwood trees; like the rest of the Piedmont and nearly all of the eastern United States, Chatham County falls within the Eastern Deciduous Forest Biome.

Within any biome, gradations in climate are further responsible for determining which species are the dominant members of their ecosystems. In North Carolina, the forests of the Blue Ridge, Piedmont, and Coastal Plain can all be distinguished according to which species of hardwoods or pines are most significant in terms of numbers or biomass. Due to its location, Chatham County contains forests dominated by the same mixture of oaks and hickories that is characteristic of the Piedmont as a whole. Chatham's proximity to the Coastal Plain, on the other hand, explains the presence of several species adapted to warmer and wetter conditions, including longleaf pine, sweetbay, laurel-leaf smilax, and bottomland animals such as the red-bellied watersnake and Carolina anole.

On a still more local level, variations in topography exert some of their main effects on biogeography by producing slightly different micro-climates from site to site. South-facing slopes possess more xeric habitats than usual, due to their more direct reception of the sun's rays. The vegetation on such sites characteristically includes such xerophytic species as post and blackjack oak, huckleberries, and St. John's wort. North-facing slopes are conversely more mesic than normal, and include a higher proportion of mesophytic species such as beech, northern red oak, and numerous wildflowers.

Although these slight differences in average temperature or moisture might not seem to be sufficient to make any great difference in terms of community composition, they may make a profound difference during times of stress. During periods of drought, extreme cold, or prolonged rainy spells, organisms inhabiting wetter, warmer, or drier topography might be able to hang on long enough for the climate to revert to normal.

As a consequence, the influence of particular microclimates on community composition can be as extreme as that of soil and rock chemistry. Perhaps the best examples of such effects are mesic communities whose distribution in the Piedmont is restricted to steep slopes that face due north. These sites remain shaded, cool and moist all summer long and retain snow and frost for longer periods in the winter than nearby areas facing only a few degrees away from true north. The presence of such conditions at sites like the White Pines Promontory and Roberson Creek Ravine explains the occurrence of species such as catawba rhododendrons, white pines, and red-backed salamanders, all of which are abundant and widespread in the mountains but found in only a handful of sites further east in the Piedmont.

These montane-like communities also illustrate another major feature of climate's effects on biogeography. Unlike topography and geology, which change extremely slowly (in human terms), one of climate's significant characteristics is its variability through time. This is illustrated not only in the fairly predictable changes in season or the more random droughts and stormy periods mentioned above, but also in longer-term alterations in annual temperature and rainfall. This adds an important historical aspect to biogeography: in order to understand the present distribution of a region's fauna and flora, it is not enough to simply understand contemporary environmental conditions; the past sequence of environments must also be considered.

As one prime example of the importance of these historical factors, the presence in the Piedmont of white pines or red-backed salamanders is now thought to be best explained by the wider distribution of cool-adapted communities during the last Ice Age, which ended 10,000 years ago. Although glaciers never got this far south, the climate of the North Carolina Piedmont during that period was far cooler than it is now. As indicated by the pollen deposits in fresh-water sediments, the entire Piedmont was covered with hemlocks, spruce, fir and other species that we now consider more northern or montane. Once the Ice Age ended and average temperatures warmed throughout the region, the distribution of these cool-adapted species shrank back to what we now observe, stranding behind small remnants wherever suitable microclimates permitted.

Visiting the White Pines Natural Area is thus like viewing a mammoth skeleton in a museum, only in this case, the exhibit is still alive and dynamic. Far from offering just a brief glimpse into the past, this small relict community, and others like it, also provide information on how highly isolated communities can survive over thousands of years as tiny fragments. This is information we will need as our own activities further break up the natural landscape and or even change the climate, setting into motion a new wave of distributional changes over the entire earth.

### NATURAL COMMUNITIES

The abiotic factors of geography, geology, soils, and climate, as just described, are highly important in determining what species occur in a particular area, from the regional level down to specific sites. Interactions between species, i.e., biotic factors, further shape the



assemblage of plants and animals that characterize a given area. Organisms that regularly occur together develop specific adaptations for living with one another. These include adaptations for predation and escape, as well as for more mutualistic interactions, as seen in pollination and animal-dependent dispersal of seeds.

This regularity of coexistence and interdependence between species leads to the concept of the "natural community" developed by ecologists early in this century. This hypothesis states that groups of organisms evolve together, forming assemblages that can be classified in much the same way as individual species. Although certain ecologists have pointed out that assemblages of organisms are variable in their composition over both time and space, emphasizing the existence of a continuum rather than discrete categories of communities, the community concept has proven durable and is particularly useful in the sort of qualitative descriptions that are employed in this survey (see Schafale and Weakley, 1990, for a further discussion of community classification for North Carolina).

One of the important applications of the community concept is that it allows predictions to be made about what species would be present in a given area in the absence of human interference. It thus provides standards for assessing the "naturalness" of sites even in regions such as Chatham County where human influences are all-pervasive. Such predictions are usually made according to the hypothesis of the "climax community". This states that for any given site there is only one stable natural community. If this community is removed through some catastrophic event (e.g., clearcutting), then the area will pass through a succession of predictable stages, each of which is characteristically transitory. At the end of this process, the site returns once again to the climax community, which is capable of persisting from that point on more-or-less indefinitely.

Although modern ecology has broadened the concept to acknowledge the role natural disturbances play in maintaining certain key features of all communities, as will be discussed below, the concepts of succession and climax remain as important as the community concept itself. With only a few exceptions, the sites included in this report can all be considered to represent either climax communities, or stages late enough in the successional process to include most of the features of the climax community.

The climax communities of the Piedmont, and indeed, most of the eastern United States, are primarily forests dominated by deciduous hardwood trees. In our particular region, oaks and hickories are the most characteristic hardwoods. Depending on local soils, topography, and microclimate, several variants of hardwood forest are possible, distinguished vegetationally according to which species of oaks, hickories, and a few other tree species are dominant. Of the 21 community types listed in Table I for Chatham County, twelve are identified mainly on the basis of their canopy species, although each of these communities also possesses characteristic species in the sub-canopy, shrub, and herb layers.

Over most of the region, Dry-mesic Oak--Hickory Forest is the most widespread natural community. As implied by its name, this community occurs on sites with moderate amounts

**Table I      NATURAL COMMUNITIES OCCURRING IN CHATHAM COUNTY**

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I. Terrestrial Communities

A. Forests

Dry-Mesic Oak--Hickory Forest  
Dry Oak--Hickory Forest  
Mesic Mixed Hardwood Forest, Piedmont Subtype  
Piedmont Monadnock Forest\*  
Basic Mesic Forest, Piedmont Subtype\*  
Basic Oak--Hickory Forest\*  
Xeric Hardpan Forest\*

B. Shrub and Herb Dominated Communities

Piedmont/Coastal Plain Acidic Cliff\*  
Piedmont/Coastal Plain Heath Bluff\*

II. Wetland and Palustrine Communities

A. Forests

Piedmont/Mountain Alluvial Forest  
Piedmont/Mountain Bottomland Forest  
Piedmont/Mountain Levee Forest  
Piedmont/Mountain Swamp Forest\*  
Upland Depression Swamp Forest\*

B. Shrub and Herb Dominated Communities

Sand and Mud Bar  
Rocky Bar and Shore  
Piedmont/Mountain Semipermanent Impoundment  
Floodplain Pool  
Upland Pool\*  
Low Elevation Seep  
Hillside Seepage Bog\*

\* Communities that are uncommon to rare in the Piedmont, particularly in Chatham County

of moisture; moderate slope, drainage, and acidity are also characteristic abiotic features. Dominant species in this community include such well-known species as white oak, southern red oak, mockernut hickory, pignut hickory and tuliptree. Red maple, sourwood and dogwood are common members of the subcanopy, while various species of viburnums and blueberries are frequent in the shrub layer. Herbs are typically sparse, as is also true for other dry, upland sites.

On slightly drier sites, primarily on south-facing slopes, more xeric oaks such as post oak, black oak, and blackjack oak predominate; the community they form is termed Dry Oak--Hickory Forest. On more mesic sites, conversely, northern red oak and American beech are prominent members of the canopy, and the community is termed Mesic Mixed Hardwood Forest. While both of these forests overlap the Dry-mesic Forest in composition, they often look quite different. The Dry Oak--Hickory Forest is usually more open, with fewer shrubs and herbs than the Dry-mesic Forest. In contrast, the Mesic Mixed Hardwood Forests are often luxuriant and possess rich displays of spring wildflowers, including such showy species as bloodroot, foamflower, hepatica, Catesby's trillium, and trout lily.

The three communities just mentioned are the primary climax forests of the Piedmont uplands. Another suite of communities dominates lowland sites along the rivers and the swamplands of the Triassic Basin. Species in these communities usually require deep, rich alluvial soils. Sugarberry, swamp chestnut oak, American elm, and black walnut are typical tree species requiring these conditions; buckeye, pawpaw, and spicebush are their counterparts in the shrub layer. Lowland species must also be able to tolerate frequent flooding. Species such as overcup oak, willow oak, and buttonbush are particularly tolerant of prolonged submergence of their roots and predominate in Piedmont Swamp Forests. Another group of trees, including sycamore, river birch and boxelder, are also flood-tolerant but more characteristic of Piedmont Levee Forests located close to the riversides.

Not all the communities listed in Table I are defined in terms of their tree composition; nine types of communities are distinguished more on the basis of their shrubs, herbs, or physical features. These include two terrestrial communities, the Piedmont Heath Bluffs and Acidic Cliffs, both of which occur on rocky slopes too steep to allow a closed canopy layer to form. Also included are riverine communities, such as the Rocky Bar and Shore and the Sand and Mud Bar, and Semi-permanent Impoundments where trees are similarly unimportant. Low-elevation Seeps, Hillside Seepage Bogs, and Upland Pools, on the other hand, all occur within forested areas but represent peculiar subcommunities associated with high moisture conditions.

As is true for individual species, communities of organisms can be distinguished as being common or rare. In Chatham County there are ten communities that are fairly restricted in their distributions; Upland Pools and Piedmont Heath Bluffs, for example, are known from less than three sites in the county, Hillside Seepage Bogs from only one. As listed in Table I, these communities include forests growing on monadnocks, steep cliffs, swamps and levees, all of which represent geographic features that depart from the typical Piedmont

terrain. Also listed are communities associated with soils that are higher in pH than the usual acidic soils of the Piedmont. Many of these sites are quite restricted in acreage but nonetheless contain a higher proportion of rare plants and animals than is true for the more widespread types of communities described above.

Before leaving the discussion of natural communities, some consideration must be given to their dynamic properties. According to the conventional theory of succession once the climax state has been reached a community enters into a sort of stasis: its species membership remains relatively constant over indefinite periods of time, changing only as the result of a major catastrophic event. As mentioned previously, however, contemporary community ecology is moving away from this static view of communities and is giving more attention to disturbances that operate on a more frequent or local basis than true "catastrophes".

A prime example of the importance of regular disturbance in maintaining community structure is seen in the relationship between fire and the longleaf pine savannas and flatwoods that once covered much of the Coastal Plain. The species composing these communities, including wiregrass, various heaths, and the longleaf pine itself, are all fire-resistant. The frequent fires that once swept across the Coastal Plain every summer following thunderstorms favored the growth of these species in an open, park-like setting. With the suppression of the natural fire regime through human intervention, these once open savannas and flatwoods have now been overwhelmed by dense growths of competing hardwoods and loblolly pines. In the older view of succession, these invading species would be considered to represent the climax community for this region, although in a truly natural environment it is they that would have been more transitory than the fire-resistant communities they supplant. In other words, the definition of the "natural" community on a given site cannot be completely equated with the climax community.

Although most of the sites identified in this report do correspond to the traditional definitions of climax communities, we have included several that would have been classically considered to represent earlier successional stages. A few of these sites, such as the Old Railroad Heath Glades and Weaver Creek Old Growth Pinewoods, are fairly xeric and open; they also possess a community composition similar to upland communities in the Coastal Plain. Even though they are now succeeding to hardwood forests typical of the Piedmont, they still show signs that they were once maintained in a more open state by fire. One conservation recommendation for these sites is that prescribed burns be used to re-open the canopy and understory.

Other sites where frequent disturbance should be considered natural include bottomlands and riparian areas, where floods reshape the landscape every year. Although transitory, oxbow ponds, beaver impoundments, and other floodplain pools are not only natural features of the bottomlands but are vital in maintaining the overall species diversity of these wetland habitats. A similar role is played by gaps created in mature forests by the fall of ancient trees. Certain definitions of old-growth forest, in fact, depend on the presence of sufficient

numbers of old trees to create frequent openings due to blowdowns. While such forests are considered "over-mature" by traditional foresters, the presence of numerous logs, standing snags, and light-gaps increase the ecological and species diversity of the stand. Natural disturbances, along with other dynamic processes, should accordingly be given increased weight in judging the quality of a natural area, even if still discounted under more commercial views of forest management.

Similar weight, however, is not usually accorded to communities shaped by artificial disturbances. Farm ponds, pine plantations, and fields recently abandoned from cultivation are rarely viewed as "natural" even though they may contain a fairly large number of "wild" species. The separation between true "natural areas" and sites showing strong evidence of human disturbance is not always easy to make, however. Several sites are included in this report that are in various stages of succession following timbering or cultivation. In all of these cases, the sites include large tracts of continuous forest. In this setting, the diversity of habitats created by human disturbance acts to increase the overall biological diversity of these tracts. Although most of the species inhabiting such areas cannot be considered truly rare, large blocks of mixed pines and young hardwoods often provide the last local refuges for some of our wariest and wide ranging wildlife, including most notably bobcat and wild turkey. They are thus important at least on a local level, as will be discussed further in the section on Conservation Priorities and Options.

#### RARE SPECIES

Most of the sites included in this report contain one or more rare species of plants or animals. As will be discussed later, the presence of rare species is one of the prime means used by the Natural Heritage Program to assess the significance of a natural area, and it was therefore one of the main criteria the authors used in determining whether a site should be included in this inventory.

Rarity, however, needs to be defined on several different levels. White pines, for instance, are quite rare in the eastern Piedmont but not in the state as a whole. The Cape Fear shiner, on the other hand, is still common in some of the streams along the Fall Line of the Cape Fear but is found nowhere else on earth. Before "rarity" can be used in site evaluations, some discussion needs to be made concerning the various schemes used to rank rarity itself. This section also describes some of the causes of rarity, which must be understood before effective stewardship measures can be planned.

Of the 74 species that are considered rare in this report, twenty are listed either by the state or federal government as special concern, threatened, or endangered, or have been designated as candidates for such listing (see Table II). Excluding the candidates, these are the only species that have any sort of legal protection in North Carolina, and estimates of their rarity status are based on extensive scientific research. Candidates are also included here because they too have some degree of official recognition, although the information

**Table II FEDERAL AND STATE PROTECTED SPECIES OCCURRING IN CHATHAM COUNTY**

**A. PLANTS**

Species	Status		
	State	Federal	TNC (NHP)
Collinsonia tuberosa (1 site) Piedmont Horsebalm	C		G3G5/S1
Fothergilla major (2 sites) Large Fothergilla	C		G3/S2
Hexastylis lewisii (4 sites) Lewis's Heartleaf	C	3C	G3/S3
Monotropis odorata (1 site) Sweet Pinesap	C		G3/S2
Panax quinquefolius (1 site) Ginseng	SC		G4/S4
Phacelia ranunculacea (3 sites) Buttercup Phacelia	C		G4/S2
Ptilimnium nodosum (1 site) Harperella	E	LE	G2/S1

Table II CONTINUED

B. ANIMALS

Species	Status		
	State	Federal	TNC (NHP)
<i>Accipiter cooperi</i> Cooper's Hawk	SC		G4/S2
<i>Aimophila aestivalis</i> Bachman's Sparrow	SC	C2	G3/S3
<i>Alasmidonta varicosa</i> (3 sites) Brook Floater	T		G3/S2
<i>Coragyps atratus</i> Black Vulture	SC		G5/S3
<i>Fusconaia masoni</i> (extirpated) Atlantic Pigtoe	T		G3/S1
<i>Gomphus septima</i> (5 sites) Septima's Clubtail Dragonfly	SR	C2	G1G2/S1
<i>Haliaeetus leucocephalus</i> (4 sites) Bald Eagle	E	LE	G3/S1
<i>Hemidactylum scutatum</i> (2 sites) Four-toed Salamander	SC		G5/S3
<i>Lanius ludovicianus</i> Loggerhead Shrike	SC	C2	G4/S2
<i>Notropis mekistocholas</i> (6 sites) Cape Fear Shiner	E	LE	G1/S1
<i>Picoides borealis</i> (extirpated) Red-cockaded Woodpecker	E	LE	G2/S2
<i>Strophitus undulatus</i> (1 site) Squawfoot	T		G5/S2
<i>Toxolasma pullus</i> (extirpated) Savanna Lilliput	T	C2	G3/S2

Table II      CONTINUED

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C. EXPLANATION OF STATUS CODES

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Federal

LE = Listed as Endangered, LT = Listed as Threatened, C1 = High Level Candidate, C2 = Low Level Candidate, 3C = Former Candidate

State

E = Endangered, T = Threatened, SC = Special Concern, C = Candidate

The Nature Conservancy & Natural Heritage Program

G1 = Critically imperiled globally because of extreme rarity (known from 5 or fewer sites worldwide) or because of some factor making it especially vulnerable to extinction.

G2 = Imperiled globally because of rarity (6 - 20 occurrences known) or because of some factor making it vulnerable to extinction.

G3 = Rare or uncommon (on the order of 6 - 100 occurrences).

G4 = Uncommon to locally abundant; apparently secure, with many known occurrences.

G5 = Widespread or common species; demonstrably secure and essentially ineradicable under present conditions.

S-ranks follow the same criteria as listed above but apply solely to population status in North Carolina. Combinations of ranks, such as G3G5 imply that the actual status is uncertain but probably lies within the range indicated.



concerning their distributional status has not yet reached the point where they can be fully listed.

Although these are the only species officially recognized as rare, the state and federal lists do not include all plants and animals for which good data suggests a high degree of rarity. Insects, for example, are not accorded any protection by the state government, no matter how rare they might be, nor do many insects graduate up from the federal candidate stage. Federal lists, moreover, are limited only to those species that are rare or imperiled at the national level and may thus skip many that are quite rare or local in North Carolina.

For insects, as well as for many other bureaucratically-overlooked taxa, the ranking system used by the Natural Heritage Program is probably the most objective available. This system was originally developed by the Nature Conservancy to provide a consistent and methodical basis for ranking species and community rarity. It is now in use throughout the network of Natural Heritage Programs and Conservation Data Centers established by the Nature Conservancy, as well as by an increasing number of governmental and private conservation organizations. In North Carolina, this system is used not only by the Natural Heritage Program but also by the Plant Conservation Program of the Department of Agriculture and by the Nongame and Endangered Wildlife Program of the Wildlife Resources Commission.

The set of ranks employed by the Natural Heritage Program to estimate both global and state rarity is briefly described in the footnotes of Table II. For the most part, only species state-ranked as S1 or S2 are actively tracked by the Natural Heritage Program (this automatically includes all species that are globally-ranked as G1 or G2 since a state-listing can not be lower than the global rank for a species). A few other species are tracked provisionally. Some of these are species that are considered rare but for which insufficient data exist to assign particular S-ranks. Others, such as ginseng, are tracked because many of their populations have been exploited to the point of local extirpation. In Chatham County, there are four species that are considered significantly rare by the Natural Heritage Program but which are not included on the federal and state lists of protected species; these are listed in Table III.

Notice, however, that even this list does not include white pines, catawba rhododendrons, or red-backed salamanders. Indeed, all these species are ranked as S5 by the Natural Heritage Program. As mentioned previously, these species are rare only in the local context of Chatham County and the eastern Piedmont. They are nonetheless quite important in evaluating the sites identified in this inventory. The three species just mentioned, for instance, are all members of the relict Ice Age communities that have managed to persist on a few steep, north-facing slopes for at least the past 10,000 years. Their loss from Chatham County might not mean much in terms of the overall survival of their species, but would be tragic in terms of loss of scientific information or simply as loss of an interesting and unique part of our natural heritage. These species, as well as 47 additional species the authors consider to be regionally rare, are listed in Table IV.

**Table III NON-LISTED SPECIES TRACKED BY THE NATURAL HERITAGE PROGRAM**

Species	NHP Rank
Hesperia metea (1 site) Cobweb Skipper	G4G5/S2?
Phalacrocorax auritus floridanus (2 sites) Double Crested Cormorant (nesting population)	G5/S1
Tachopteryx thoreyi (3 sites) Thorey's Grayback Dragonfly	G4/S2
Villosa constricta (3 sites) Notched Rainbow Mussel	G3/S3

Table IV REGIONALLY RARE SPECIES

A. PLANTS

Adiantum pedatum (4 sites) Maidenhair Fern	Galax aphylla (5 sites) Galax
Amsonia tabernaemontana (6 sites) Blue Star	Gaultheria procumbens (1 sites) Wintergreen
Aristida virgata (1 site) Three Awn Grass	Lechea leggettii (1 site) Legget's Pin-weed
Aureolaria flava (1 site) Yellow Oakleach	Lemna perpusilla (3 sites) Small Duckweed
Calystegia sepium (1 site) Hedge Bindweed	Lindernia dubia (1 site) Yellowseed Pimpernel
Campanula americana (1 site) Bluebell	Lycopodium obscurum (3 sites) Shining Clubmoss
Cardamine bulbosa (2 sites) Bulbous Bittercress	Orontium aquaticum (1 site) Golden Club
Carex jamesii (1 site) James' Sedge	Oxypolis rigidior (1 site) Stiff Cowbane
Chaerophyllum procumbens (1 site) Wild-Chervil	Pinus palustris (1 site) Longleaf Pine
Clethra alnifolia (1 site) Coastal Sweet-pepperbush	Pinus strobus (2 sites) White Pine
Dicentra cucullaria (2 sites) Dutchman' Britches	Rhododendron catawbiense (1 site) Catawba Rhododendron
Eleocharis tortilis (1 site) Spikerush	

Table IV CONTINUED

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B. ANIMALS

<i>Acris gryllus</i> (1 site)	
	Southern Cricket Frog
<i>Allothrombium</i> sp. (1 site)	
	Sumo Mite
<i>Anguispira fergusonii</i> (2 sites)	
	a landsnail
<i>Anolis carolinensis</i> (4 sites)	
	Carolina Anole
<i>Corvus ossifragus</i> (1 site)	
	Fish Crow
<i>Desmognathus auriculatus</i> (1 site)	
	Southern Dusky Salamander
<i>Lutra canadensis</i> (7 sites)	
	River Otter
<i>Lynx rufus</i> (2 sites)	
	Bobcat
<i>Melanerpes erythrocephalus</i> (4 sites)	
	Red-headed Woodpecker
<i>Meleagris gallopavo</i> (6 sites)	
	Turkey
<i>Mephitis mephitis</i> (1 site)	
	Striped Skunk
<i>Mesomphix</i> sp. (4 sites)	
	a landsnail
<i>Mniotilta varia</i> (1 site)	
	Black-and-White Warbler
<i>Neonympha areolata</i> (1 site)	
	Georgia Satyr
<i>Nerodia erythrogaster</i> (1 site)	
	Red-bellied Watersnake
<i>Pandion haliaetus</i> (2 sites)	
	Osprey
<i>Picoides villosus</i> (1 site)	
	Hairy Woodpecker
<i>Plethodon cinereus</i> (2 sites)	
	Red-backed Salamander
<i>Tamias striatus</i> (4 sites)	
	Eastern Chipmunk

As outlined in Table V, the reasons for the rarity of a species involve a number of different factors, all of which need to be considered in making planning and conservation decisions. In the case of the Ice Age relicts, for instance, nothing short of global cooling will expand their habitat in the Piedmont. While we cannot substantially increase their range in Chatham County, we can at least see that their tiny remaining habitats suffer no further losses. The same is true for a number of other species that are rare primarily because of their association with restricted habitats. For species like freshwater mussels or bald eagles, on the other hand, we can actually bring about an expansion of their populations by correcting our own abuses of the environment. These are actions that will also benefit the human inhabitants of the county.

Fifty-four of Chatham's species are rare mainly due to natural causes. The majority of these species (32) are of only marginal occurrence in the Piedmont; their main centers of distribution are either the Mountains (12 species) or the Coastal Plain (20 species). The montane group can be further subdivided into two main groups. The first, representing Pleistocene relicts such as white pine, catawba rhododendron, and red-backed salamander are widely isolated from their main distributions northward and westward. The second and larger group includes species such as galax and eastern chipmunks that have a more-or-less continuous distribution east of the mountains but which thin out towards the coast as the climate gets hotter and drier. These species, as well as the Coastal Plain marginals, are generally more likely to recolonize this part of the Piedmont if removed than are the Pleistocene relicts. Once gone, the white pines and red-backed salamanders will require another ice age to bring about their return. Other factors being equal, this should confer a higher priority for protection to the relictual group than the marginals.

The remaining 22 species listed in the naturally-rare category include the Piedmont as part of their main distribution, and are rare primarily because they have habitat requirements for certain types of soils, climatic conditions, or other factors that are sparsely distributed in this region. Some of these species, such as buttercup phacelia and harperella, occur in other provinces as well, but always as widely isolated populations; the reasons for their rarity are not well-understood. Also included in this group is the one species that is truly endemic to this region, the Cape Fear shiner. As is true for the Pleistocene relicts, the populations of this group of species are now so widely isolated that dispersal between them occurs rarely if ever. Again, the removal of any one of their populations represents an irretrievable loss, at least without active, and usually expensive, restoration efforts by human helpers.

The second part of Table V lists 17 species that have declined dramatically as the result of human-caused factors. This group is not mutually exclusive of the first, and contains unfortunate organisms such as Septima's clubtail dragonfly and the Cape Fear shiner which were rare enough to begin with, due to narrow habitat requirements, and which have been all but exterminated due to pollution and other human-caused alterations of their habitats. While the survival of any of the county's rare species should be considered precarious, this particular group presents perhaps the greatest challenge for conservation efforts, since these are the species most at risk from the expansion of the human population and industry.

Table V CAUSES OF RARITY

A. SPECIES THAT ARE RARE FOR BIOGEOGRAPHIC REASONS

1. Pleistocene relicts

Campanula americana  
 Dicentra cucullaria  
 Mesomphix sp.  
 Monotropsis odorata  
 Pinus strobus  
 Plethodon cinereus  
 Rhododendron catawbiense

2. Northern marginals (non-relict)

Galax aphylla  
 Gaultheria procumbens  
 Mniotilta varia  
 Stenanthium gramineum  
 Tamias striatus

3. Coastal Plain or Southern Marginals

Acris gryllus  
 Aimophila aestivalis  
 Aristida virgata  
 Clethra alnifolia  
 Corvus ossifragus  
 Desmognathus auriculatus  
 Eleocharis tortilis  
 Lechea leggettii  
 Lemna perpusilla  
 Neonympha areolatus  
 Nerodia erythrogaster  
 Orontium aquaticum  
 Oxypolis rigidior

3. Continued

Phalacrocorax auritus floridanus  
 Pinus palustris  
 Sabatia brachiata  
 Smilax laurifolia  
 Symplocos tinctorium  
 Vaccinium crassifolium  
 Woodwardia virginica

4. Piedmont Endemics or Species with Narrow Habitat Requirements

Adiantum pedatum  
 Amsonia tabernaemontana  
 Aureolaria flava  
 Calystegia sepium  
 Cardamine bulbosa  
 Carex jamesii  
 Chaerophyllum procumbens  
 Collinsonia tuberosa  
 Fothergilla major  
 Gomphus septima  
 Hemidactylum scutatum  
 Hexastylis lewisii  
 Incisalia henrici  
 Lindernia dubia  
 Lycopodium obscurum  
 Notropis mekistocholes  
 Panax quinquefolia  
 Phacelia ranunculacea  
 Ptilimnium nodosum  
 Sicyos angulatus  
 Tachopteryx thoreyi  
 Valerianella radiata

Table V CONTINUED

B. SPECIES THAT HAVE BEEN REDUCED BY HUMAN-CAUSED FACTORS

Species	Causes		
	Pollution	Overexploitation or Persecution	Habitat Loss
<i>Accipiter cooperi</i>	+	+	
<i>Aimophila aestivalis</i>			+
<i>Alasmidonta varicosa</i>	+		
<i>Coragyps atratus</i>		+	+
<i>Fusconaia masoni</i>	+		
<i>Gomphus septima</i>	+		
<i>Haliaeetus leucocephalus</i>	+	+	+
<i>Hesperia metea</i>			+
<i>Lanius ludovicianus</i>	+		+
<i>Lutra canadensis</i>	+	+	
<i>Lynx rufus</i>		+	+
<i>Meleagris gallopavo</i>		+	+
<i>Notropis mekistocholas</i>	+		
<i>Panax quinquefolius</i>		+	
<i>Pandion haliaetus</i>	+		
<i>Picoides villosus</i>			+
<i>Pinus palustris</i>			+
<i>Strophitus undulatus</i>	+		
<i>Villosa constricta</i>	+		

There are three main categories of human-related causes for the decline of wild species. Again, these causes are not mutually exclusive and some species are affected by all three. Earlier in our history, but continuing in some case until quite recently, overhunting and other forms of direct exploitation were the main factors responsible for the decline or outright extinction of many animals, as well as of a few plants such as ginseng. Passenger pigeons, Carolina parakeets, beaver, wolves, bison, elk, and mountain lions were all eradicated from North Carolina by the end of the 19th Century. The same fate almost befell white-tailed deer and wild turkey, although enlightened wildlife management practices have succeeded in restoring their numbers. The beaver has also been successfully reintroduced into our state. Given current statutes governing hunting, probably none of Chatham County's existing species can be considered imperiled due to this cause alone<sup>9</sup>.

More important today are the effects of pollution and other forms of habitat loss. Pollution alone is implicated in the decline of eleven of Chatham's species. The near demise of bald eagles, ospreys, cooper's hawks, and other fish- and bird-eating raptors has been conclusively tied to the past use of DDT; the recovery of their populations was possible only after this pesticide was completely banned in United States in the mid 1970's.

Other species still face this threat. Many species of freshwater fish, insects, and particularly mussels are still in danger of complete extinction due to water pollution. Two of Chatham's former species, the Atlantic pigtoe and the savanna lilliput mussel, have been lost due to pollution of the Rocky River, most likely due to poorly treated effluents or excess chlorine released from the Siler City Wastewater Plant<sup>10</sup>. Five others, including the Cape Fear

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<sup>9</sup> The one possible exception is the fox squirrel, which probably once occurred along the southern border of the county in association with longleaf pines, Bachman's sparrows, and red-cockaded woodpeckers. While habitat loss is the major reason for the decline of this species, it is still hunted throughout the state and this additional pressure could be highly important in reducing its populations on the margins of its range, including areas in Chatham County. We found no evidence that this species still occurs in the county, however, and for that reason we have not included it in the lists of Chatham's rare species.

<sup>10</sup> During the 1970's, bypasses of raw sewage into the Rocky River followed almost every heavy rain, primarily due infiltration and inflow the plant could simply not handle. There were also episodes of excess chlorine dumped into the effluent as a disinfectant. Both of these factors have been strongly implicated as reasons for the decline in both freshwater mussels and the Cape Fear shiner in the Rocky River since the early 70's. Currently, water quality in the Rocky River is given an extremely poor biological rating between Love's Creek, the site of the outfall for the Siler City Wastewater Plant, and Tick Creek, located approximately seven miles downstream. Pottern, G. 1990. Op cit. Carter, J.H. 1990. Biological assessment for Siler City

(continued...)



shiner, Septima's clubtail dragonfly, brook floater mussel, squawfoot mussel, and notched rainbow mussel have been likewise reduced by pollution and now hang on only in the lower reach of the Rocky and adjoining reaches of the Deep River and Bear Creek. Until the Siler City plant is upgraded, none of these species has a chance of reclaiming their former habitat. Moreover, the hydro dam above US 15-501 may preclude any natural recovery in the upper reaches of the Rocky, and direct transplantation may be the only way to restore their numbers to a viable level in the county.

The hydro dam and other dams located on the Cape Fear, Deep, and Haw Rivers are representative of the third major factor reducing the diversity of the county's native species, outright destruction and fragmentation of habitats. As indicated in Table V, the decline of eight of the county's species can be attributed to habitat loss of this sort and in the coming decades this number can be expected to swell enormously. Cutting of forests, elimination of natural fires, introduction of exotic species, as well as the construction of dams, highways, and housing developments will inexorably whittle away at all of the county's natural resources.

Some appreciation of the problems involved in conserving endangered species and their habitats can be obtained from a discussion of the species occurring in Chatham County that are on the state and federal lists of protected species. In many cases, multiple causes exist for the rarity of these species. Multiple solutions will also be required for their recovery, none of which will be easy to achieve.

#### *Listed Plants of Chatham County*

Only one plant species in Chatham County is federally listed. *Harperella*, a member of the parsley family, is restricted to scoured gravel bars and rocky shoals in swift-flowing streams. Its habitat has been depleted by altered stream flows resulting from dam construction and from siltation produced by cultivation, clear-cutting, and other human activities. Over the entire nation, this species has been reduced to just ten populations spread over six states. The small Deep River population, located just downstream from the White Pines Promontory, is one of only two extant populations in North Carolina. Alterations in the natural flow patterns of the Deep River produced by the proposed Randleman Dam may make the future of this population doubtful.

Ginseng, state-listed as Special Concern because of its heavy exploitation as a highly valued medicinal herb, is rare east of the upper Piedmont. Its one known Chatham population is found in a habitat that possesses a nutrient-rich soil and a cool, shaded microclimate -- conditions resembling those of the rich cove forests of the mountains where this species

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<sup>10</sup>(...continued)

Wastewater Treatment Plant Improvements. Application to Expand the Siler City Wastewater Plant; Appendix C2.

grows more abundantly. Ginseng could possibly occur in other sites in Chatham County, particularly on other rich, non-acidic, and shaded lower slopes where herbs such as bloodroot, mayapple, and maidenhair fern are also found.

Buttercup phacelia appears as a spring ephemeral in a narrow zone in seasonally inundated floodplain forests along the Haw and Cape Fear Rivers. While it occurs by the millions in those sites that fit its requirements, such habitats are few in number. In North Carolina this species is confined to the Cape Fear drainage. Changes in flooding patterns created by the construction of dams or the removal of water for municipal usage could have a critical effect on this narrowly-distributed species.

Another little known plant, Piedmont horsebalm, was discovered in Chatham County for the first time during the course of this inventory. Its one occurrence in the county is from the same Basic Mesic Forest that is the site for the county's one recorded population of ginseng. Such habitat is rare in the Piedmont, and that is probably the main reason for the rarity of this species.

Another plant with a widely scattered distribution in the North Carolina Piedmont is sweet pinesap. The exact causes for its rarity are unknown. It may be a Pleistocene relict, since it tends to occur on steep, shaded north-facing slopes. It may also be more widespread than it appears, since this is an easily overlooked little herb. In Chatham County, this species is only known from one forested ravine in the granitic area found in the northeastern part of the county.

One other rare plant that occurs sporadically for reasons that are not known is Lewis's heartleaf. In North Carolina, the distribution of this species is restricted to the lower Piedmont and Coastal Plain. In Chatham County, its three known populations all occur in forested areas in the Triassic Basin, all on acidic, silica-rich soils.

#### *Listed Animals of Chatham County*

By far the most significant species found in Chatham County, plant or animal, is the Cape Fear shiner. This species occurs only in the Cape Fear River basin of North Carolina. Although it probably once inhabited all the major rivers and larger streams in the vicinity of the Fall Line, it has been steadily declining at least since 1971 when it was first described<sup>11</sup>. As mentioned previously, the primary reasons for its decline are dam construction and pollution. It is now entirely missing from several areas where it had once been found, including Roberson Creek in central Chatham County and probably the entire Haw drainage basin. Currently this species is only known from three sites: near the Randolph-Moore County line in the Deep River, in Neill's Creek in Harnett County, and in the lower Rocky

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<sup>11</sup> Selson, F.F. 1971. *Notropis mekistocholas*, a new cyprinid fish endemic to the Cape Fear River basin, North Carolina. *Copeia* 1971:449-462.

and Deep Rivers in the vicinity of their confluence<sup>12</sup>. The last-named site contains by far the largest remaining population of the shiner, and has been designated as Critical Habitat for this species by the US Fish and Wildlife Service.

This same area is also critical habitat (but unofficially) for several extremely rare aquatic invertebrates that hover on the brink of extinction along with the Cape Fear shiner. In fact, next to the shiner, the rarest species that occurs in Chatham County is Septima's clubtail dragonfly, a species that again has its largest world population in the lower reaches of the Rocky and Deep Rivers. Although this species was originally described in the 1950's from a river in Alabama, that site has been subsequently destroyed by an impoundment and only five other populations have been discovered anywhere else, two of them in Chatham County. In addition to the large, previously known population in the lower Rocky and Deep Rivers, we discovered another population in the Haw during the course of this inventory.

The reasons for the rarity of this species are not entirely understood, but flooding of riffle habitat by impoundments and the runoff of pesticides into the rivers from agricultural and urban areas are thought to be major factors.

The lower Rocky and Deep Rivers, along with Bear Creek, are also one of the region's last strongholds for several freshwater mussels. The continued existence of eight species in this area was confirmed during the course of this inventory, and we were especially encouraged to find small populations of the squawfoot and brook floater, both state-listed as threatened, and the notched rainbow, listed as significantly rare by the Natural Heritage Program. However, we only observed one or two individuals of each of these species, and we found no signs of recent reproduction (such as juveniles or small adults). Two species of yet rarer mussels, the Atlantic pigtoe and Savanna lilliput, state-listed as endangered, were not found at all, although both were reported from the Rocky as recently as the 1970's<sup>13</sup>.

Although few people are even aware of their existence, freshwater mussels are in fact one of the most imperiled group of all our organisms. Most of the streams in North Carolina are now entirely devoid of native mussels; where any remain, there are usually only one or two hardy species instead of the dozen or more that once occurred. Of the 63 species that have been recorded in North Carolina, 55% are now officially listed by the state as endangered, threatened, or special concern (another 33% are too little known to be sure of their rarity

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<sup>12</sup> Pottern, G.B. and Huish, M.T. 1985. Status survey of the Cape Fear shiner, Notropis mekistocholas. Report to US Fish and Wildlife Service. NCSU Cooperative Fishery Research Unit; Raleigh.

Pottern, G.B. and Huish, M.T. 1986. Supplement to the status survey of the Cape Fear shiner, Notropis mekistocholas. Report to US Fish and Wildlife Service. NCSU Cooperative Fishery Research Unit; Raleigh.

<sup>13</sup> Shelley, 1987. Op cit.

status). Perhaps only in the lemurs of the rapidly disappearing forests of Madagascar can there be found as large a family of animals suffering a comparable rate of endangerment.

The reasons for the mussels' downfall are easy to trace: virtually everything we do seems to have an adverse impact on these extremely sensitive monitors of environmental quality. Runoff from cultivated fields, clear-cuts, road-construction, pipeline emplacement and other projects involving earth-moving all produce sediments that either bury the mussels outright or clog their delicate gills, leading to starvation if not suffocation. As filter-feeders, they also ingest virtually all contaminants we dump into our waters. Ammonia, heavy metals, pesticides, herbicides, other organic pollutants, and particularly the chlorine used to disinfect municipal wastewaters have all been linked to the decline of mussel populations<sup>14</sup>.

Furthermore, we found evidence throughout the entire drainage that there is a rapidly swelling population of the introduced Asiatic clam, *Corbicula*. This species is more pollution-tolerant than the native mussels and appears to displace the original inhabitants in degraded watersheds. Particularly disturbing were the great shoals of dead *Corbicula* shells we found in November of 1990 below the hydro dam above US 15-501, a site that had previously supported the rare Atlantic pigtoe and brook floater mussels. The fact that there were so many recently dead *Corbicula* suggests that a major die-off had just occurred, and if *Corbicula* succumbed in such large numbers then mortality must have been even more severe in the less hardy native species. In fact we observed only a few shells of the relatively hardy eastern *Elliptio* in the reach between the dam and the mouth of Bear Creek.

Although the dragonfly and mussels just mentioned clearly deserve federal protection, the only other federally-listed animal occurring in Chatham besides the Cape Fear shiner is the bald eagle. Its fate, however, is far more optimistic than those just described: the main factor responsible for its global decline, DDT poisoning, has been remedied at least in this country, and the eagles are now increasing in numbers. In some cases, moreover, the bald eagle has actually prospered due to human modification of the environment, particularly through the creation of large reservoirs. In Chatham County, for instance, this species became resident only after the creation of Jordan Lake.

On the other hand, the breeding population of this species in North Carolina is still quite small. Only eight nesting pairs are currently known, including one pair at Jordan Lake. Protection of nesting sites is now the most important means of increasing the numbers of this species, and that, in turn, requires some sacrifice on the part of humans who use lakes and

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<sup>14</sup> As in the case of the Cape Fear shiner, the decline of the mussel populations in the Rocky is directly linked to the discharge of poorly treated wastes from Siler City Wastewater Plant or its overuse of chlorine as a disinfectant (Pottern, 1990). Although the Savanna lilliput and other mussels were observed below the US 64 bridge back in the 1970's, we found no evidence for any species of native mussel now occurring between Love's Creek and Tick Creek.

sounds for recreation. That this will be no easy task can be seen in the controversy created by a plan to reduce disturbance to the nesting pair at Jordan by restricting human activities in the vicinity of the nest trees during the breeding season.

Another raptorial bird that was all but eliminated by DDT is the cooper's hawk. Unlike the bald eagle, this species was once common throughout the forests of the Piedmont. Although it never was listed as endangered, neither have its numbers rebounded the same way as have ospreys, pelicans, or the bald eagle itself. The actual number of breeding pairs in Chatham is unknown; this species is a highly secretive forest bird. They are certainly still quite scarce, if possibly on the increase. None is known to occur in any of the natural areas identified in this survey, although several of these areas, particularly the larger tracts of woodlands, offer suitable habitat.

The loggerhead shrike, in sharp contrast to the two raptors just mentioned, is still declining, not only in North Carolina but throughout eastern North America. Although pesticides have been suspected as a cause for these losses -- this species feeds heavily on insects, small birds, and rodents in agricultural areas -- the exact effects have been difficult to pin down; nesting failures of the sort linked to DDT poisoning in other species has not been observed in shrikes. There is also a possibility that habitat loss is responsible. This species lives primarily in pasture land, especially where there are scattered shrubs or hedgerows. Reduction of cattle ranching, clearing of hedgerows, decreased use of barbed wire, and other changes in agricultural practices may have all contributed to the demise of this species, although plenty of apparently suitable habitat remains.

Although the exact reasons for the decline of this once common Piedmont bird remain to be identified, it is certainly vanishing fast. We observed only three pairs during the course of this survey, none of which were associated with any protectable natural area.

Changes in agricultural practices are more clearly linked to the decline of the black vulture. In North Carolina, black vultures were once commonly associated with large livestock operations, where carcasses were frequently left out on the open range. With the increasing move of poultry and pig-farming indoors, and with the enactment of stringent sanitary laws prohibiting the dumping of carcasses, this species has been forced to look elsewhere for its sustenance. The Chatham County population is currently the largest in the state, but is essentially unprotectable by means of natural area protection. Some effort, however, should be made to protect the communal roosting sites used by both this species as well as the more common turkey vulture.

Habitat loss is also clearly implicated in the decline of the Bachman's sparrow. Along with already vanished red-cockaded woodpecker, this species is strongly associated with the open pine savannas and flatwoods that once occurred widely in the Coastal Plain and parts of the adjacent Piedmont. In Chatham County, a few pairs still persist in the southeastern part of the county, where scattered longleaf pines can also be found (and where red-cockaded woodpeckers last occurred in the county). In this area, they are now found only in a few

large, grassy clear-cuts that mimic the open conditions once present in the savannas. When the loblolly pines that have been planted in these areas mature, this species will probably also be lost from the county. As was true for the black vulture and shrike, none of the natural areas identified in this inventory supply appropriate habitat for this species, although in some cases the restoration of a natural fire regime might bring back suitable conditions, particularly in the area around the Old Railroad Heath Glades and Devil's Tromping Ground.

The four-toed salamander is still another species limited primarily by habitat, although in this case the restrictions appear to be due to natural causes. Like many amphibians, the four-toed salamander requires fish-free pools or springs for its larval development. This species further requires that large patches of sphagnum or other species of moss are located close to the water's edge. Females usually lay their eggs in communal masses beneath moss, where one or more of the females tends them for up to six weeks. After the eggs hatch, the larvae drop into the water where they develop for another six week period. Sites having both large amounts of moss and sufficient water throughout the larval period are few and far between. Not all such sites are occupied, moreover; this species tends to be highly localized and colonial. Two colonies were discovered during the course of the inventory, and only two others have been reported from Chatham County, both in areas that in other respects did not qualify for inclusion in this inventory. Due to the highly localized nature of this species, its presence in Chatham County is threatened by clear-cutting of bottomland forests, drainage of wetlands, and sewer-line construction within stream valleys.

