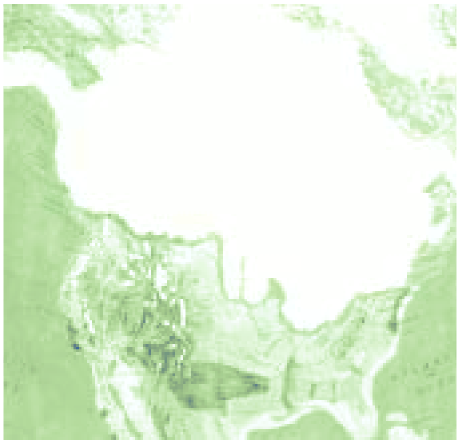

Chapter 24: Background Paper: Historical Overview of the Southern Forest Landscape and Associated Resources

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Key Findings

- The Wisconsin glaciation of North America peaked around 18,000 years before present (BP) freezing much of the Earth's fresh water in its massive 2-mile thick ice sheet covering nearly 5 million square miles. The forest vegetation was drastically different from our modern forests.
- Climate changed from arid-cool (18,000 years BP) to arid-hot (7,500 to 5,000 years BP) to the current warm-humid climate of the Southeast.
- Humans were well established in the Southeast around 12,000 years BP with fire as their equalizing tool to master the environment. Besides climate, fire was the single most important influence that shaped pre-European forest flora and fauna.
- Climate change, natural disturbance, fire, and humans have constantly affected the vegetative landscape by generating environmental stress or benefit for various species as modern vegetation assemblages developed. These factors contributed to a major extinction of megafauna at the end of the Pleistocene epoch (11,000 to 10,000 years BP).
- American Indian populations in the Southeast were estimated to be 1.5 to 2 million with the development of agriculture. They continued to use fire frequently on a wide scale to clear land and maintain open woods and favorable wildlife habitats.
- The introduction of European diseases had immediate impact on American Indians, causing a population collapse of 90 to 95 percent by 1700. The advent of Europeans and their economic systems impacted American Indian culture and their ability to manage ecosystems by fire, which began a change in composition, structure, and pattern of forest vegetation throughout the Southeast.

Introduction

Had the first descriptions of North America occurred 18,000 years ago, our impression of the vegetation would be very different from that which was recorded 500 years ago by early European explorers. Vegetation 18,000 years ago was radically different than at present (figs. 24.1 and 24.2). How do we know this? The information used to compile the story has many sources. Since no one was around to leave a written record for most of the time, we must depend on science to weave the picture of events over this long period of time. Written historical records began after 1492. Eyewitness descriptions of Amerindians, their culture, the wildlife, and the landscapes they lived on have only been available for 500 years.

Archaeologists have been instrumental in developing knowledge of past human cultures. Their discoveries allow us to see how people lived and interacted with their environments. Paleoecologists have found undisturbed natural ponds, bogs, and other undisturbed wetlands to sample pollen grains deposited over thousands of years. Ecologists and botanists use this information to determine the climatic conditions necessary to support the various species of plants identified from pollen samples. Other ecologists study fire behavior and how fire affects plants and wildlife. Geologists add to our historical understanding by studying landscape and climatic changes related to the movement of glaciers. After the arrival of Europeans, eyewitness descriptions of the landscape and its inhabitants offer a resource rich in information. The combination of all of this professional knowledge is needed to tell this story.

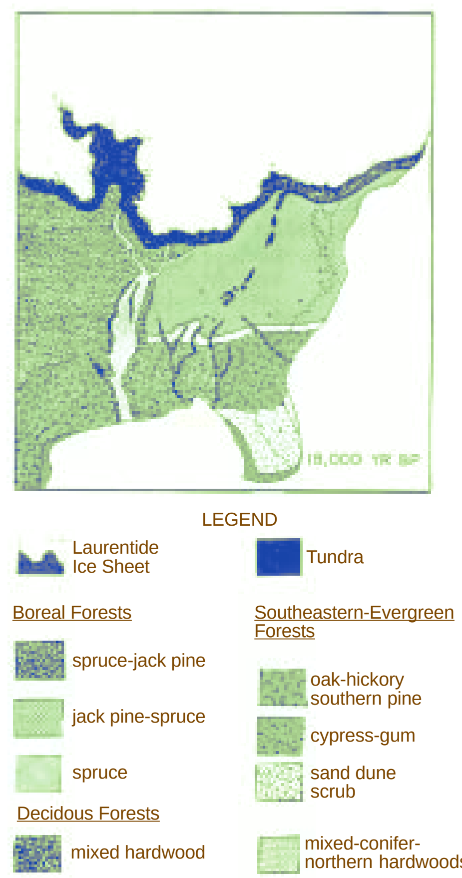


Figure 24.1—Paleovegetation map For 18,000 yr BP (Delcourt and Delcourt 1984).

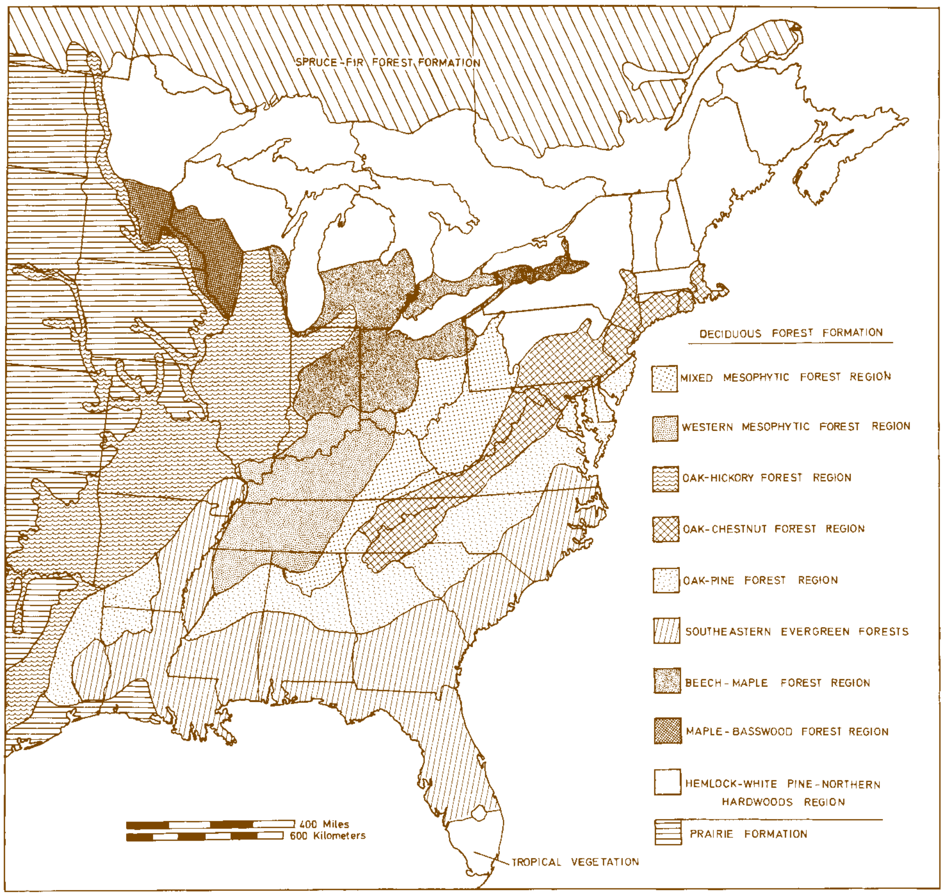


Figure 24.2—Map of potential vegetation types of the Eastern United States (modified from Braun 1950).

The Late Pleistocene Epoch (Ice Age 27,000 to 9,500 Years Before Present)

Research indicates that the late Wisconsin glaciation began to advance about 25 to 27,000 years before present (BP) (Andrews 1987), and that maximum glaciation occurred at 18,000 years BP. Geologists refer to the 2-million year period of Ice Age as the Pleistocene Epoch. During the late glacial period, the Wisconsin, two large ice caps, the Laurentide glacier in the East and Cordellian Glacier in the West, dominated northern North America. Nearly all of Canada lay under the two massive glaciers, which extended into the northern regions of the United States and into the southern one-third of Alaska (fig. 24.3).

These two massive ice sheets were part of an even larger system of ice that dominated the northern hemisphere. Nearly a quarter of the Earth's surface lay under the weight of a mountain of ice. The Laurentide ice sheet is believed to have reached a height of 12,500 feet (Hughes 1987). Ice covered nearly 5 million square miles of North America. As the glaciers grew, they drew more than 50 percent of the Earth's available water, affecting precipitation (Delcourt and Delcourt 1979). The ocean levels dropped, exposing what we call the Continental Shelfs. The expansion of the glaciers dramatically affected the distribution and composition of vegetation.

The leading edge of the glacier in the United States is believed to have been over a mile high (Hughes 1987). Nothing could stand in the way of this massive ice field as it pushed south, grinding over mountains and

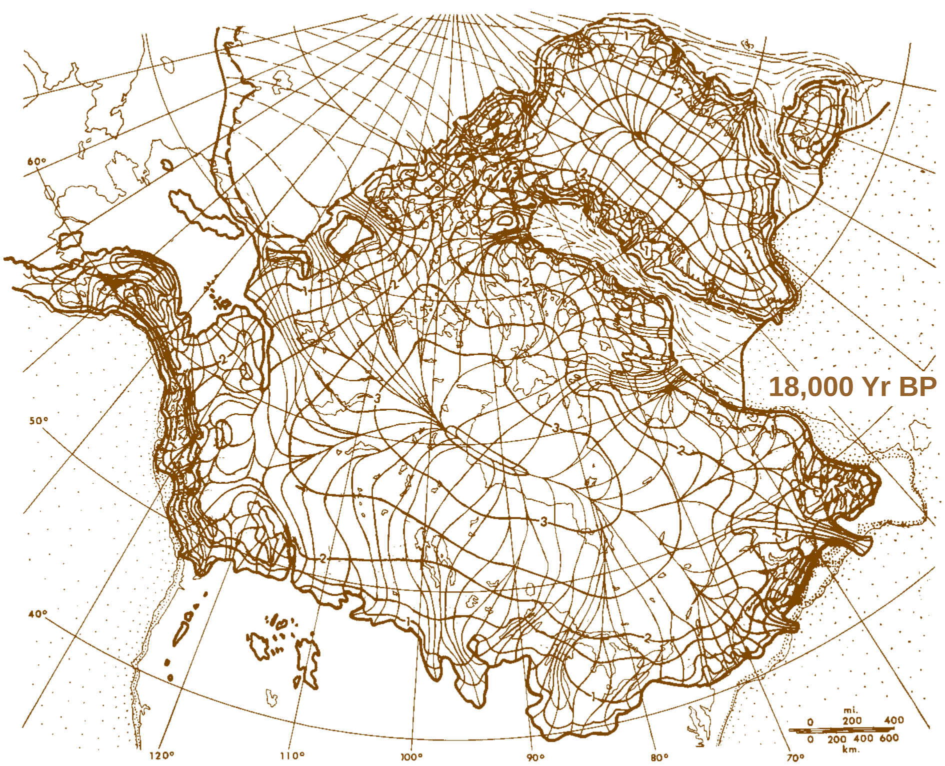


Figure 24.3—The last glacial maximum in North America simulated by a geomorphic model. Ice-elevation contour lines are shown at 0.5-km intervals at 18,000 yr BP. Surface flowlines drawn normal to surface contour lines are solid for grounded ice and dashed for floating ice. Ice-sheet margins are heavy solid lines and ice-shelf grounding lines are heavy broken lines. The edge of the Continental Shelf is taken as the 0.5-km bathymetric contour and is shown as a thin line beyond present-day coastlines. The extent of seawater is the dotted area (Hughes 1987).

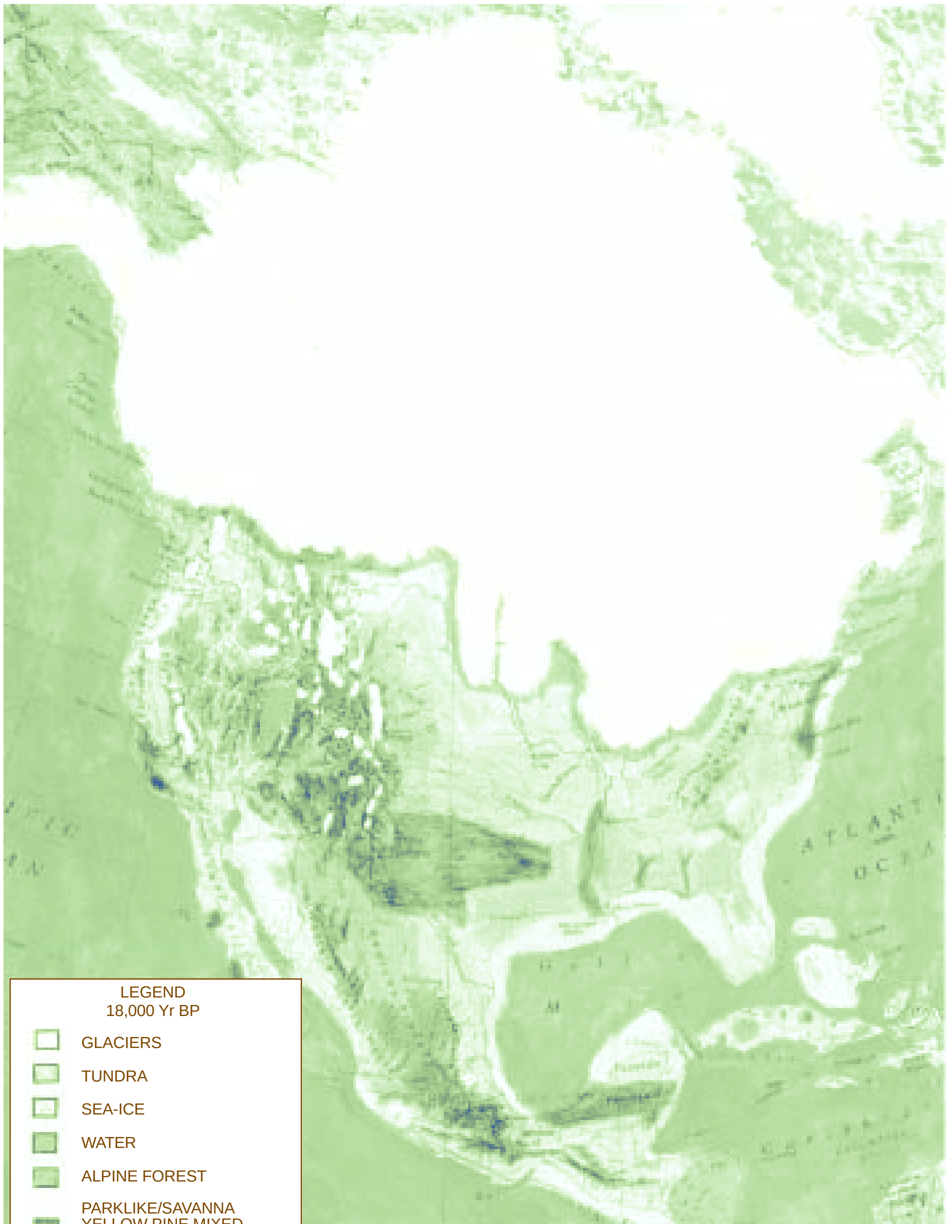


Figure 24.4—Maximum extent of North American glaciers and a generalized concept of vegetation based on less precipitation in most areas (modified from Delcourt and Delcourt 1985, Martin and Mehringer 1965, data from the Center of Climatic Research 2000).

depressing the land under its massive weight. Over the ice caps, a huge high-pressure system pushed the polar jet stream southward, dominating weather patterns over much of the northern hemisphere (Barry 1983, Kutzbach 1987). The ice sheets influenced temperatures far to the south, and both vegetation and wildlife retreated in its front (Graham and Mead 1987, Jacobson and others 1987). The vegetation map (fig. 24.4) depicts the magnitude of the glaciers and the proportion of Earth's water frozen into the 12,000-foot thick ice sheet and graphically illustrates the extent vegetation was influenced by this glacial system.

By 18,000 years BP, boreal species dominated by jack pine and spruce had been pushed as far south as 34° N. latitude, which is near present-day Atlanta, GA. Temperate deciduous tree species dominated by oaks existed just south of the broad boreal region. Temperate forest species extended south onto the exposed Continental Shelf into the Gulf of Mexico (Delcourt and Delcourt 1984, Watts 1980) (fig. 24.1).

Full Glacial Landscape (18,000 Years BP)

Pollen core samples provide clues to tree distribution and composition of the full glacial landscape, but they must be interpreted with caution when making broad statements about the complex characteristics of forest types. Because all pollen cores are taken from mesic sites (wet areas), like bogs, natural ponds, pocosins, etc., mesic species may be overrepresented.

Delcourt and Delcourt (1984) developed a vegetation map for Eastern North America for 18,000 years BP, based on a number of pollen studies scattered throughout North America (fig. 24.1). This map represents the potential distribution of vegetation types in regions of Eastern North America. Delcourts' map shows boreal forest in the Southeast to 34° N. latitude. Jack pine was the dominant species followed by spruce, and oak formed a minor component near the boreal/deciduous interface near 34° N. latitude (Watts 1980). Below 34° N. latitude, oaks were the dominant tree species with hickory as an associate. However, the excessively dry climate of the time affects vegetation assemblages throughout the Southeast (Barry 1983, Delcourt and Delcourt 1979). A potential misinterpretation of the oak-hickory and boreal species assemblage, as depicted, is that it may give the impression of a completely forested landscape.

It is evident from the massive dimensions of the glacial systems and their influence on worldwide precipitation that what is termed forest at 18,000 years BP did not have a closed canopy. Rather, trees were scattered over a dry landscape, occupying sites where moisture and growing conditions were favorable for tree survival and growth (fig. 24.5). And what about the size of individual trees? Under these droughty conditions, many soil types in the South may have supported only scrub trees, or no trees at all. Extensive areas were probably dominated by prairie or sagebrush-dominated areas (Watts 1980) (fig. 24.5). Delcourt and Delcourt (1979) have estimated that current mean annual precipitation may have been reduced by more than half during full glaciation. Reducing present mean annual precipitation for the Southeast by more than 50 percent produces climatic conditions similar to the arid areas of the West today (U.S. Department of Agriculture 1965) (fig. 24.6).

Significant herbaceous pollen (grasses, sagebrush, and smartweed) appears in the profile from White Pond, SC (fig. 24.7). This quantity of herbaceous pollen would not be possible under a closed canopy forest (Watts 1980). Away from this mesic site, on xeric (dry) uplands, drought-tolerant grasses and sagebrush probably dominated the landscape.

Due to the extremely arid climate, vegetation consisted of trees clumped in favorable locations or scattered over the landscape in open park-like savannas, in association with prairies and scrublands. Organization of the vegetation mosaic was controlled by the moisture gradient from the well-drained uplands to the moist areas of the bottomlands.

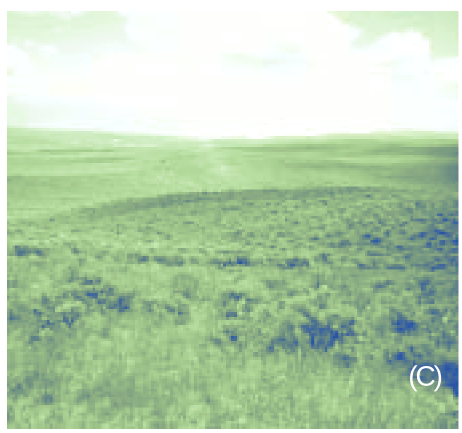


Figure 24.5—Dramatically lower mean annual precipitation in the Southeast during the ice age created an arid climate similar to our present Southwestern United States. Trees would have existed only in favorable locations (A) and (B). Extensive areas of droughty soils in the Southeast would have only sustained grasslands, and scrubland landscapes (C).

Precipitation was also greatly reduced in the now super-humid Appalachian Summit. The arid climate produced a mosaic of grasslands, park-like savannas, and tundra at higher elevations. Dominant tree species were firs and spruces on moister sites with jack pine occupying drier sites (Delcourt and Delcourt 1984, Watts 1983).

South of 34° N. latitude, the deciduous tree assemblage dominated by oaks and hickory was able to survive. The arid climate and variations in soil types also produced a mosaic of park-like savannas with extensive prairies, sagebrush, and scrublands. Large grazing mammals existed throughout the South and required large amounts of herbage to live. Their existence supports the idea of extensive rangeland in the South because that habitat would have been necessary for their survival (Graham and Mead 1987, Guilday 1982, Kurten 1988, Lundelius and others 1983).

As a result of the arid climate and lower ocean levels, rivers and water tables were considerably lower (Edwards and Merrill 1977). Riparian areas, seeps, and springs provided a refuge for moisture-loving trees such as beech. Delcourt and Delcourt (1979) theorize that the eastern escarpment of the Mississippi River and the eroded

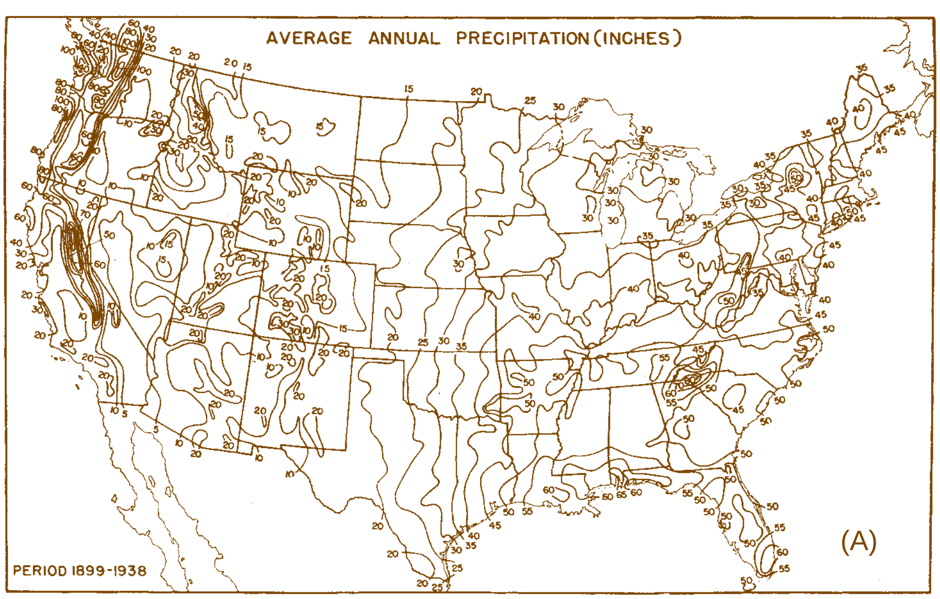
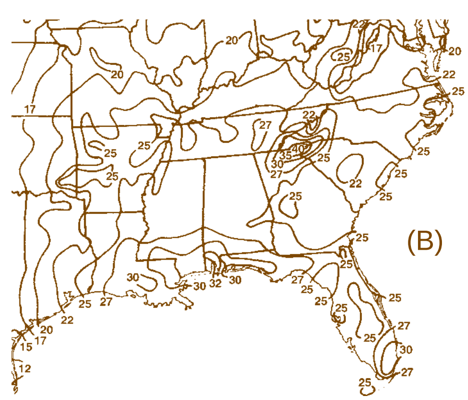


Figure 24.6—Present mean annual precipitation for the United States (A). The mean annual precipitation in inches at 18,000 yr BP is shown in (B). For most of the 2 million years of the ice age the mean annual precipitation was significantly less than today (modified U.S. Department of Agriculture 1941).



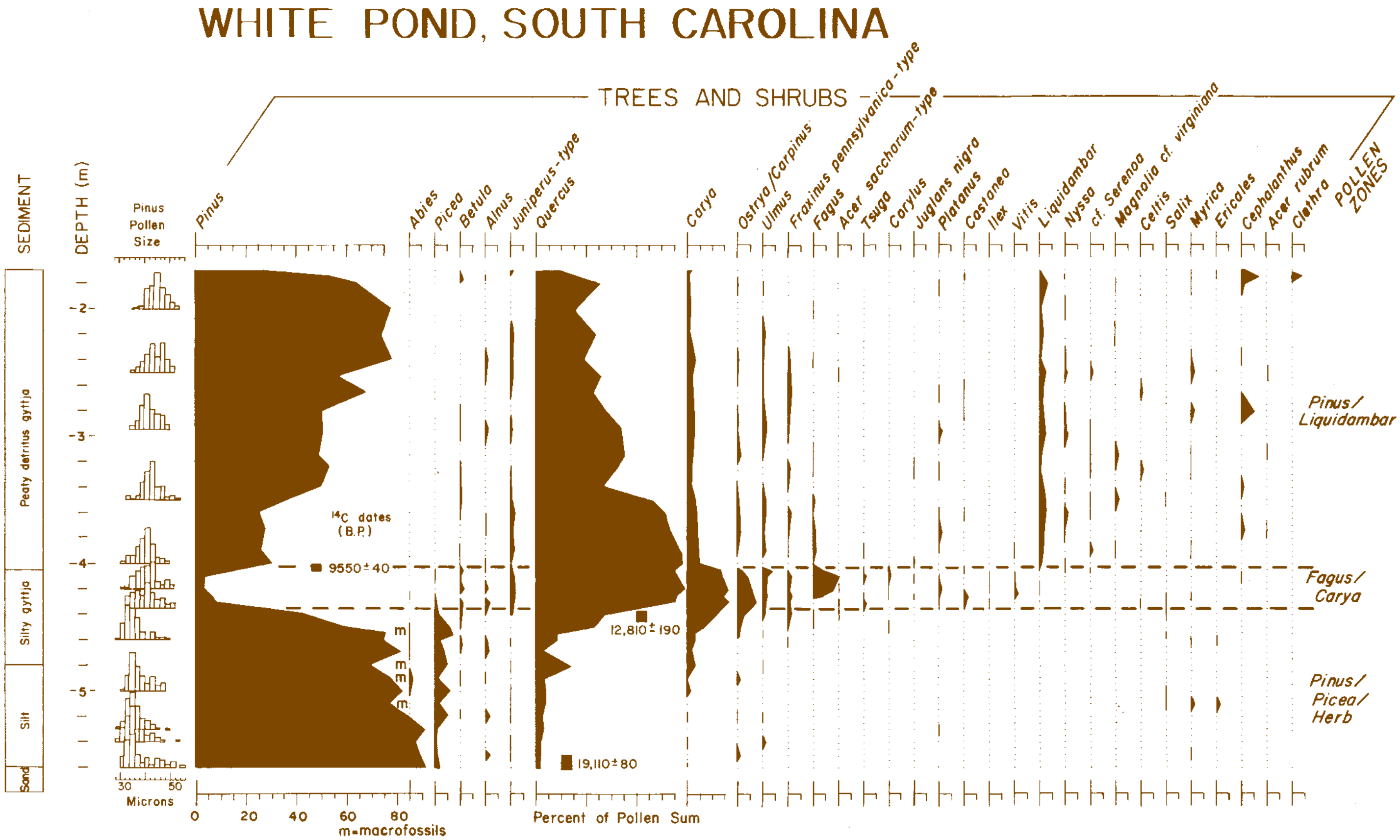
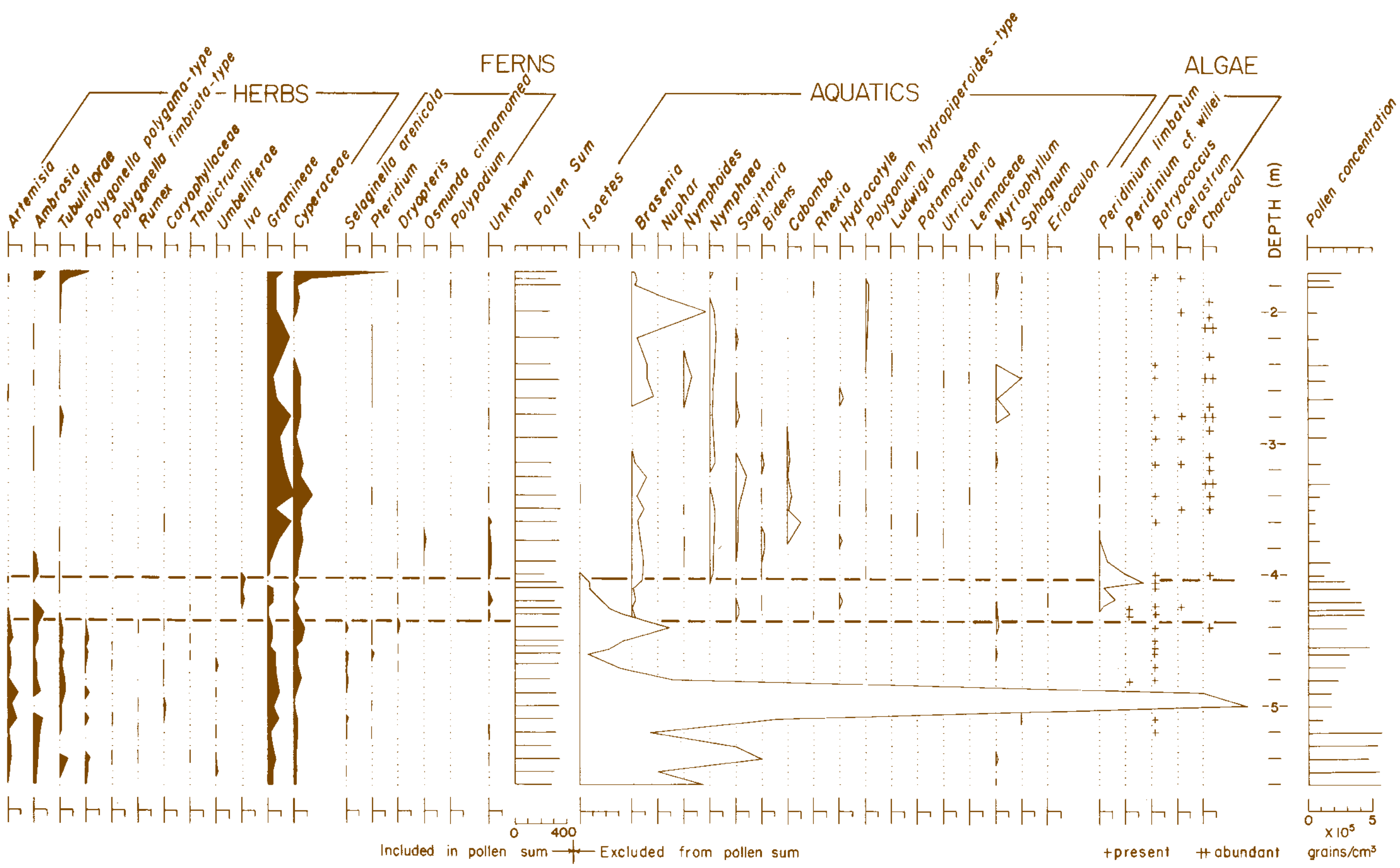


Figure 24.7—Pollen profile from White Pond, SC; an early pollen profile study. Other southeastern sites have added knowledge of vegetation composition during the past 18,000 years (Watts 1980).



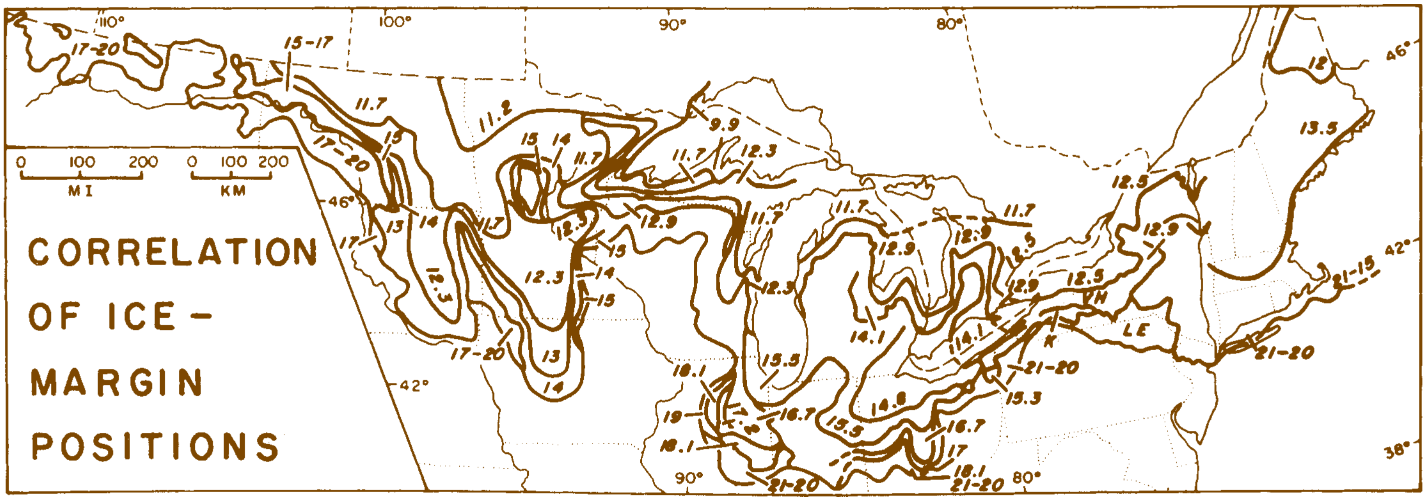


Figure 24.8—Late glacial record of the Laurentide Ice Sheet. Tentative correlation of ice-margin positions or readvance limits. Areas where no ice-front positions are shown are poorly known. Ages are in thousands of years before present (Mickelson and others 1983).

gorges where streams entered the river provided refuge for many tree species during full and late glaciation. They also suggest these landscape features provided important migratory routes for tree species during changing climates.

Beaver may have been important during this period for creating inundated wetlands that supported shrubs and mesic herbaceous plants. These wet habitats probably attracted many species of wildlife, as well as waterfowl displaced by the glaciers.

Ocean levels are believed to have been 400 feet lower than at present. The exposed Continental Shelf extended from 60 to 90 miles beyond the present shoreline (Edwards and Merrill 1977, Jacobson and others 1987) and is believed to have harbored northern hardwoods in the vicinity of the Carolinas. This exposed and relatively flat land would have contained bogs and swamps interrupted with scrublands dominated by deciduous species along with southern pine.

Ice Age Wildlife

The vegetation provided habitat for many wildlife species that are either extinct or extirpated from the region today. Fossil evidence for full-glacial fauna in the Southeast is scarce because the highly humid climate and soil types deteriorate fossils. However, in areas where limestone is found, such as Florida, Tennessee, Kentucky, West Virginia, parts of the Coastal Plain, and in natural bogs, some fossils have been preserved. These fossils provide evidence of diverse wildlife species that existed during the Ice Age (Guilday 1982). The abundance of wildlife may have been partially due to a more moderate climate created by the large glaciers, without the extremes of our more continental weather today (Kurten 1988).

The glacier squeezed boreal, temperate, and subtropical ecosystems into a smaller land area. Wildlife species adapted to boreal conditions could easily migrate seasonally to forage in neighboring temperate or even subtropical ecosystems.

Webb (1981) reports the presence of wooly mammoths as far south as Charleston, SC, where fossil records indicate that tapirs and capybaras were also found (Kurten 1988, Webb 1981). Fossil records of the boreal region during full glaciation include wooly mammoths, horses, caribou, bison, moose, black bears, beaver, and several species of musk oxen, among many other species.

Temperate region fossils include browsers such as mastodons, elk, white-tailed deer, sloths, peccaries, and grazers such as Columbian mammoths, bison, horses, llamas, along with black bears, beaver, spectacled bears, and a host of other species.

The subtropical region included many of the same species found in the temperate and boreal regions plus tapirs, capybaras, and alligators. Guilday (1982) reported that mammal diversity during this time consisted of at least 75 species. This number is 32 percent greater than mammals represented when Europeans arrived. In addition, 26 mammal species at full glaciation were large, compared to 6 large species in 1500.

The diversity of grazers and browsers supports the hypothesis of great ecological diversity. The landscape of scattered copse and individual trees mixed with grasslands formed numerous vegetation edges (ecotones) no longer present in the South (Guilday 1982, Webb 1981).

Changing Glacial Climate (16,500 to 9,500 Years BP)

Pollen samples from the Eastern United States indicate vegetation changes in response to a glacial retreat around 16,500 years BP (Delcourt and Delcourt 1984). The retreat was not constant but was interrupted by at least six or seven advances, each lasting 700 years. However, no advance reached the glacial maximum of 18,000 years BP (fig. 24.8). A number of physical changes in the glaciers were associated with the glacial retreat. By 12,500 years BP, the extent of the Laurentide glacier had slightly diminished, but the height of the dome had decreased by more than half to 5,900 feet (fig. 24.9) (Hughes 1987). The glaciers now contained 25 percent of the Earth's water available for precipitation (Kutzbach 1987).

Although somewhat less massive, the glacier continued to dominate

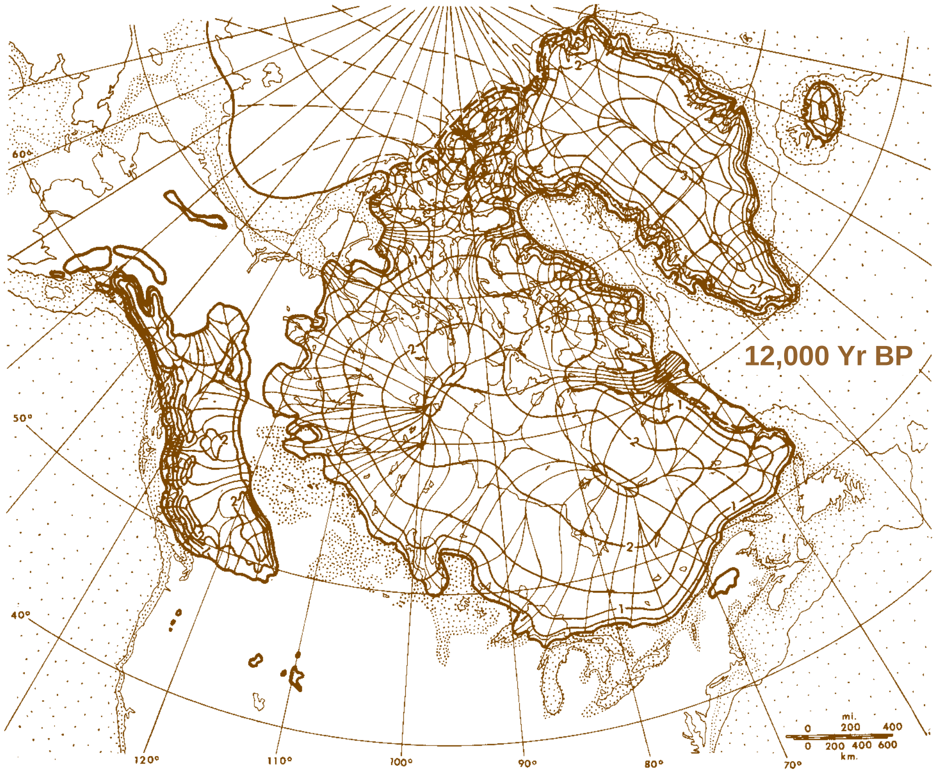


Figure 24.9—The glacial sheets of North America at 12,000 yr BP (Hughes 1987).

the climate of the United States, and especially land east of the Mississippi River. A significant ice cap still covered most of Canada (Hughes 1987) (fig. 24.9). After 16,500 years BP, the glacial retreat was occasionally interrupted by readvances brought on by temperature fluctuations. Readvances were within 100 to 200 miles north of the maximum extent of 18,000 years BP. This occurred at least three times during the late glacial phase—at 12,900, 11,700, and 9,900 years BP (Edwards and Merrill 1977, Mickelson and others 1983) (fig. 24.8). Logically, the increased presence of ice during readvances came at the expense of precipitation over the continent.

Precipitation models indicate that current precipitation averages were not attained in the Southeast until after 9,500 years BP (Kutzbach 1987). Webb and others (1987) also reported that annual precipitation in the Southeast remained below present levels. Barry (1987) states that temperature and precipitation rose in the Southeast between 12,800 to 10,000 years BP but remained below modern averages. Kutzbach (1987) reported lower sea-surface temperatures in the western Atlantic, which contributed to reduced summer temperatures in the Southeast. Summers were droughty, which controlled vegetation composition and distribution. This information supports a drier climate as opposed to a climate with abundant precipitation as indicated by Delcourt and Delcourt (1984).

The retreat of the glacier was accompanied by a rise in ocean levels. By 12,000 years BP, the ocean rose to within 30 to 60 miles of the present shoreline. The rising ocean, accompanied by an increase in mean annual precipitation, lifted coastal river levels, increased streamflow, and raised water tables. However, both sea level and precipitation remained lower than at present (Edwards and Merrill 1977).

Late Glacial Vegetation (12,500 to 9,500 Years BP)

The glacial retreat strongly affected vegetation distribution and composition. Tree species began migrating inland away from encroaching ocean waters, as well as northward due to climatic warming. Mesic species took advantage of the increased moisture in riverine watersheds. Since the Laurentide glacial dome continued to cover eastern and middle Canada, the direction of most of the retreat was from west to east. The remaining large ice dome in the east prolonged the glacial climate along the eastern seaboard. The earlier warming in the western South explains the early development of a spruce and oak assemblage prior to 12,500 years BP in the Ozark Highlands. The prolonged cooler climate in the East maintained the presence of spruce in Virginia as late as 10,000 years BP or later (Wright 1987).

As the glacier waxed and waned between 16,500 to 12,500 years BP, vegetation dynamics were intense. Edwards and Merrill (1977) described this period as "ecologically restive." The assemblage of tree and plant species had no modern analogue (Davis 1983). Boreal vegetation and tundra moved into newly opened land in the northern regions abandoned by the massive ice fields. Boreal forest in the Eastern United States by 12,500 to 11,000 years BP ranged south in a broad band into Virginia and Kentucky (37° latitude) and farther south, narrowing along the Appalachians summit into North Carolina and Tennessee. Here, residual boreal species exist today at high elevation.

Deciduous trees, especially oak, dominated the taxa over much of the South. Mesic hardwoods, such as ironwood, beech, and maples, were important along river systems and wet areas. Watts (1980) research at White Pond in South Carolina indicated the presence of a deciduous forest dominated by oaks at 12,800 years BP. The oaks associated with hickory and beech made up as much as 55 percent of the nearby tree species; some ironwood and hornbeam were present (fig. 24.7). He concludes that the climate was cooler and moister than today, implying that the forest was "mesic", but he urged caution in using this term.

Delcourt and Delcourt (1984) also refer to climate at this period as "cool-temperate" supporting mesic forests. They theorize that abundant moisture was available during the growing season in the mid-latitudes of the Southeast north of the 34° N. latitude. However, there is reliable information to suggest that between 12,500 to 10,000 years BP the climate of the Southeast was cooler but drier, rather than moister than at present. During the late glacial period the ocean level was still 100 to 130 feet lower than at present, and river levels and water tables were correspondingly lower. Lower precipitation, particularly during the summer growing season, would have had profound effects on vegetation (Kutzbach 1987).

Watts (1980) and Delcourt and Delcourt (1984) proposed a mesophytic forest during the late glacial period north of the 34° latitude. However the mesic hickory-beech association composed only 25 percent of the pollen at that time (fig. 24.7). The dominant pollen at White Pond, SC, for the period 12,800 to 10,000 years BP was the shade intolerant, ring-porous, drought resistant oak. Hickory, which comprised 15 percent of the pollen profile, is also ring porous and should be considered part of the oak assemblage. Oak, therefore, was the dominant forest type at the time. It dominated the upland areas. Mesic species, such as beech, ironwood, hornbeam, elm, ash, and maple, were assigned to the waterways or moist areas such as White Pond. Therefore, the pollen evidence from White Pond supports a dry climate rather than a moist climate.

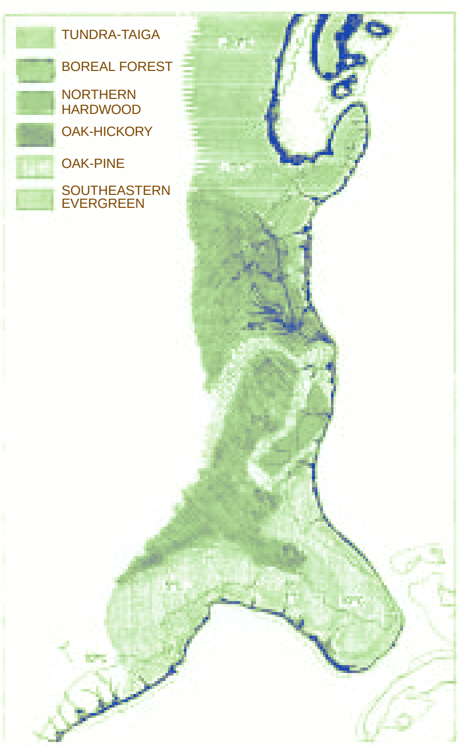


Figure 24.10—Forest types for 12,000 yr BP along the eastern seaboard with average temperatures for this period. The climate is relatively dry and terrestrial vegetation that needs moisture is found near rivers and other moist sites. Oak and hickory dominate most uplands of the Southeast. Boreal species inhabit the mountains, while southern pine is a multiplying component of the southeastern Coastal Plain (modified Edwards and Merrill 1977).

The map by Edwards and Merrill (1977) (fig. 24.10) represents a plausible model for dominant tree taxa at 12,500 years BP for the Atlantic Seaboard, based on a drier climate. Jacobson (1987) also supports a dry climate by indicating that the oak-hickory forest was dominant over the entire Southeast at this time. Oaks and hickories produce leaves rapidly in the spring when soil moisture is highest from winter recharge and transpiration is low, and they have the ability to produce and store energy at leaf flush. If droughty weather occurs later in the growing season, they shut down their systems and wait for sufficient soil moisture. They are shade-intolerant species and need repeated disturbance to maintain quality regeneration on all sites (Brose and Van Lear 1998). Without disturbance in high precipitation regions, oaks and hickories have difficulty competing with diffuse-porous mesic species and lose their dominance in the stand or disappear altogether.

Late Glacial Landscapes—Mesic Or Xeric?

Soil types, drainage, and aspect strongly influence vegetation composition and distribution. In the Southeast, the Piedmont, Sandhills, and Highland Rim consist of rolling uplands, ridges, and hills. Sandy Coastal Plain soils are well drained. These landscapes were dissected by riverine drainages. Even with current levels of precipitation, upland and deep sandy soils are well drained or excessively drained and droughty.

Since it has been established that the climate at 12,500 to 9,500 years BP was more arid than today, the landscape would have supported fewer and smaller trees. The lack of precipitation during the summer growing season (Kutzbach 1987) would drastically reduce tree growth. Only the hardiest trees would survive, and the droughty conditions would enhance the frequency of fire. On droughty sites, grasses would be favored because they are more drought and fire tolerant. The harsh conditions resulted in widely spaced trees in park-like savannas, enhancing both browsing and grazing potential for wildlife. In many areas, only scrubby forms of oak and pine could survive extended drought.

In Florida during the late glacial period, the water table was 50 feet lower than today (Watts 1971). Throughout the Southeast, forests along the rivers were probably open, with rich herbaceous plant communities on river terraces. This condition may explain the increased presence of ironwood and hornbeam pollens in core samples during this period. Further support for open forests was reported by Jacobson and others (1987), who said, "the widespread appearance of ironwood, in particular, supports the notion that a broad woodland of open-grown vegetation existed south of the ice sheet; this tree flowers and produces abundant pollen only when growing in well lighted conditions." Davis (1983) indicated that the abundance of ironwood pollen in early Holocene sites in New England is compatible with a drier climate and a higher fire frequency. Ironwood today is characteristic of woodlands in Minnesota, growing along the prairie margin where fires are frequent. Delcourt and others (1999) also postulated a climate that promoted frequent fires favored taxa such as ironwood and hornbeam. They also noted that disturbances would have created patchy sunlit spots for the weedy growth of ironwood and hornbeam in shrubby thickets near mesic sites.

Ironwood and hornbeam made up less than 10 percent of the pollen profiles at mesic sites north of the 34° N. latitude where the cool temperate mesic forest was proposed (Davis 1983, Delcourt and Delcourt 1984, Watts 1980). Considering all the evidence, it appears that ironwood and hornbeam were growing in open conditions rather than in a closed canopy forest.

Advent of Humans (12,000 to 9,500 Years BP)

In 1926 near Folsom, NM, a cowboy made a fundamental discovery that changed the thinking about the antiquity of humans in the Americas. He discovered the skeleton of an extinct form of bison (*Bison occidentalis*) lying in an arroyo. What was remarkable about the skeleton was that it had a stone spear point located in its rib cage. This was the first reported discovery of human association with extinct Ice Age animals. This spear point style was named Folsom and believed to be at least 10,000 years old. The creation of a new point on the time line for human arrival in the Americas generated much excitement. Previously, professionals placed the earliest humans in the Americas between 4,000 and 5,000 years ago (Fagan 1987).

In 1936 near Clovis, NM, a new and different spear point was discovered in association with the remains of an extinct mammoth, as was another found in 1959 at Lehner, AZ. These spear points were named Clovis. Clovis points were found in stratified soil layers below the Folsom points and radiocarbon dated at 11,340 years BP (Fagan 1987). This discovery established the Clovis culture as the earliest undisputed culture in the Americas.

It is important to understand that the arrival of humans in the Americas had significant impacts on vegetation and wildlife distribution, diversity, and abundance. Since the dates for humans in Eurasia and Africa precede those for the Americas, it is believed that they migrated from Eurasia to the Americas. Originally, it was widely believed that people of the Clovis culture emigrated from Siberia to the Americas via a land bridge. Glaciation lowered ocean levels exposing submerged land, creating a land bridge between Eurasia and the Americas (fig. 24.4). As the glaciers slowly retreated, an ice-free corridor was created in western Canada sometime after 13,000 years BP that could have allowed the first humans to penetrate the Americas (fig. 24.9). Recently it has been determined that this ice-free corridor was probably uninhabitable during this period, due to extremely harsh conditions. Additionally, archaeologists have not found any evidence of the Clovis culture at the time the ice-free corridor existed.

There are possibly some sites of early human habitation in both the Americas that predate the Clovis period, which has led to the speculation of a pre-Clovis culture. New theories have evolved from these speculations. The first Americans could have skirted the glaciers before 12,000 years BP by migrating along the northwest Pacific coast in small boats as they either fished or hunted marine animals. A more recent theory suggests an Atlantic Ocean route from Europe. This theory is based on lithic similarities of spear points between Clovis and those of the European culture (Anderson and Faught 1998, Parfit 2000, Roosevelt 2000).

The discovery of Clovis points in association with extinct megafauna labeled Clovis people as big-game hunters. A widespread romantized view developed of fur-clad people in pursuit of or in direct confrontation with the massive mastodon, mammoth, or giant bison. These images have changed little in the decades since the discovery of Clovis points. However, increasing archaeological evidence implies a more complex existence for these people, which is more in keeping with the complexity of human beings in general.

These early Americans, like most hunter-gatherers, were opportunists. Evidence clearly indicates they hunted the now extinct megafauna; but they also hunted many other animals, such as deer, elk, caribou, peccaries, and smaller animals like rabbits. They also took fish and gathered wild plants (Anderson and Faught 1998).

Some archaeologists have dismissed extinct megafauna hunting in the East. They believe only extant wildlife such as deer, elk, or caribou were taken. Other archaeologists believe that the Clovis culture may have developed in the Southeast (Anderson and Faught 1998). The highly complex personal stone tool kits of the southeastern and eastern Clovis people were as well developed and of identical size as those of their western Clovis cousins (Anderson and Faught 1998, Cotter 1991, Dragoo 1976, Fagan 1987). This similarity suggests that the Clovis people in the Southeast were hunting similar species of wildlife as their western cousins during the same period. Increasing archaeological association of Clovis culture with extinct fauna in the Southeast confirms this belief (Anderson and Faught 1998).

One reason for the confusion about species hunted by the Clovis culture is the belief that the vegetation of the Southeast between 12,500 to 9,500 BP was closed-canopy mesic forest with abundant rainfall during the growing season (Delcourt and Delcourt 1984). A more plausible description of the southeastern landscape is that it was an open park-like mosaic of scrubland, prairies, and savannas (Edwards and Merrill 1977). This type of habitat is required by megafauna, which indisputably lived in the Southeast. The arid climate of the late glacial period produced extensive megafauna habitat, especially on well-drained droughty soils of the Piedmont, the Sandhills, the Highland Rim, and sandy Coastal Plain soils. Some of the largest concentrations of Clovis artifacts are found in the Southeast in immediate association with these droughty areas (Anderson 1991).

Clovis hunters (12,000 to 10,500 years BP) and later Paleo-Amerindians (10,500 to 9,500 years BP) were hunter-gatherers who traveled in small mobile bands of loosely related kinsmen and functioned as a social unit for economic purposes. These small bands of about 40 people covered extensive territories in their "seasonal rounds" of food procurement. Seasonal movements were structured to optimize the procurement of food (Blanton and Sassaman 1989, Hudson 1976).

During the fall, several related bands would join for ceremonial activities and hunting. The synergistic effort of the larger unit procured large quantities of meat to be dried for winter consumption. As the fall season progressed and game dispersed due to hunting pressure, the bands also dispersed to more favorable hunting areas until the arrival of spring (Hudson 1976, Walthall 1980).

In the spring, activities included gathering of plants, fishing, and collecting shellfish (fresh water mussels). Hunting, fishing, and plant gathering continued throughout the summer.

Human Ecology

The techniques for procuring food had been learned over thousands of years. Wing and Brown (1979) observed, "Not only must people eat regularly, but the cost in terms of energy expenditure of obtaining and using food cannot be greater than the energy derived from these foods." Associated with this cost is another factor . . . risk. Examples of regions that are high risk for human survival are deserts or arctic regions. Risk is also involved with the species hunted (Champion and others 1984). Since

Clovis people sometimes hunted animals, such as mastodon or mammoth, the risk versus the benefits of confronting such colossal animals had to be calculated. A direct confrontation was life threatening, but the potential benefits were enormous. Hunter-gatherers needed an economical and efficient food-gathering strategy. A group must minimize cost and risk, and maximize food quantity and predictability. Innovative hunting and gathering techniques sought an optimized time, place, and harvest quantity. An annual cycle, called the “seasonal round”, was designed around seasonal changes in plant abundance and wildlife behavior (Champion and others 1984, Hudson 1976, Lee and DeVore 1968).

These successful techniques can be observed today in extremely high-risk areas such as the Kalahari Desert of Africa. In only 2 1/2 days, adult Bushmen procure food resources that exceed energy requirements for 1 week (Lee and DeVore 1968).

Cowdrey (1983) states that the “southeastern natives could live off the landscape’s natural resources, using manual labor for only about one-fourth of the year’s subsistence.” The reported acumen of hunter-gatherers rules out any thought of their wandering aimlessly across the landscape in search of the next meal.

Humans are the only creatures on Earth that for thousands of years have reasoned, organized, and carried out plans for their survival in almost every climate on Earth. Without this ability, people would not have populated the Earth but would have remained isolated in some benign niche or even become extinct. Humans have never been mere observers of nature; they have always employed their observations to directly manipulate the environment for their benefit. This process evolved beyond mere survival but enhanced abundance for a better quality life.

Natural climatic disturbances, including fire, created diversity in the ecosystems. The disturbed areas favored many plants and trees that produced berries, nuts, or forage. Since fire was the one natural tool that could be controlled, it became the agent for modifying the landscape. Humans could now mimic natural disturbances over a large territory to enhance plant and wildlife populations for hunting and gathering.

Managed Human Ecosystems

There is growing scientific evidence that at a very early period humans manipulated vegetation to attract game and improve food-gathering possibilities. In Europe as early as the Acheulian Period (250,000 years BP) and later during the upper Paleolithic Period (80,000 to 25,000 years BP), fire was used to drive game and enhance vegetation quality. Some forests were deliberately cleared as indicated by pollen analysis from various locations in England. An open forest with scattered trees and clearings produced fresh enriched and palatable sprouts attractive to many wildlife species (Champion and others 1984, Kurten 1972). These open forests favored plants that require more sunlight, such as species that produce fruit. These plants were likely to be trees that produce nuts (oaks) or plants that produce soft fruit such as raspberry. The open forests not only attracted wildlife that could be eaten but provided vegetation for direct consumption. Pollen analysis in Denmark indicates that closed-canopy forests prevailed there around 12,000 years BP, creating survival problems for humans. In response, they reduced the forest overstory with fire. In turn, this disturbance led to increases in human settlements (Champion and others 1984, Kurten 1972).

Migratory patterns of large herbivores can cover large areas and be unpredictable. The occurrence of more diverse and abundant plant resources, results in a greater diversity and abundance of wildlife species (Champion and others 1984). The manipulation of vegetation by prehistoric humans can be viewed as structured hunting. Herds were attracted to locations by improving foraging opportunities. According to Champion and others (1984), this manipulation of wildlife blurs the distinction between hunting and other forms of exploitation and may be considered semi-domestication (Hudson 1976). Perhaps these techniques were the foundations of animal domestication.

Similar manipulation was applied in the Southeast (Hudson 1976). The descendants of Eurasian people brought the ancient tool that could change landscapes: fire!

Prehistoric Fire

Fire has had a long relationship with humans. It is not known when we first tamed fire, but it was very long ago. The folklore of many cultures contains stories of taming fire. Generally, the arrival of fire in these cultures is related to stealing fire or receiving it as a gift from a Supreme Creator (Hoebel 1972, Hudson 1976). Southeastern tribes believed that fire was the earthly representative of the sun. Fire was from the Upper World and was so sacred that it was reverently addressed before any ceremonial proceeding and never polluted with water, which was from the Lower World. In August at the beginning of a new year, all fire was extinguished and rekindled anew. High Priests warned that those people who failed to extinguish their fires properly would be punished by the divine fire (Hudson 1976).

Fire performed many functions for southeastern Indians. Corrective fires were used to open up the older stagnated timber stands to enhance food production (Bonnichsen and others 1987, De Vorsey 1971). Fire was used to control pests such as ticks and mosquitoes. Even the smoke, which was an integral part of the sacred fire, was believed to purify the air for breathing by eliminating lurking diseases (De Vorsey 1971).

Fire provided safety from predators because of their natural fear of fire. Fire offered warmth and light and created a sense of security. It cooked food, and it dried meat and fruit for later use.

Humans penetrated remote and unpopulated areas of Europe, Asia, and finally the Americas by following a retreating glacier. Surviving the cold and brutal climate was only possible because of fire. “Fire could have made the difference between survival and extinction in the regions occupied by human beings” (Coon 1954).

Fire was an equalizer, allowing humans to drive game and confront prey and predator. Fire was the commanding tool that not only allowed humans to survive, but also provided a margin of comfort. It gave humans greater mastery of their environment, and it was around campfires that the first seeds of civilization were planted.

Late Paleoindians (10,500 to 9,500 Years BP)

Evidence places the demise of the Clovis culture at about 10,700 to 10,500 years BP (Blanton and Sassaman 1989). This change may have been due to climatic changes, which affected hunting strategies. Even during the Clovis period some changes in spear point style were noted in some southeastern locales, such as Cumberland and Suwanee. These changes in technology were slight and continued to reflect Clovis culture.

However, by 10,500 years BP, a shift in spear point size is apparent in Quad and Simpson points. This size reduction may be attributable to changing subsistence activities (Milanovich and Fairbanks 1980, Walthall 1980). By about 10,000 years BP, a number of new spear point styles were being made. Hardaway and Dalton spear points, considered transitional technology from the Paleo to Archaic Period, represent a possible shift toward smaller territorial exploitation and an increasing reliance on hunting more modern game species, such as deer, elk, bison, turkeys, and squirrels (Coe 1952, Goodyear 1982, Goodyear and others 1979, Walthall 1980). These are the same species that continued to be hunted by southeastern Indians until Europeans arrived. Also, there seems to have been an increase in gathering of foods, such as hickory nuts, walnuts, acorns, and fruits, suggesting a changing culture and possibly more defined territories (Goodyear 1982, Walthall 1980).

The patterns for seasonal rounds in the Southeast were being established during this period. In the fall, hunters and their families moved to favorable hunting grounds to hunt deer and gather nuts and late-season fruits for winter. At these locations, fire was used to drive game and clear out brushy areas to enhance spring fruiting plants, as well as to encourage more palatable forage for wildlife.

Burning the underbrush also reduced concealment of large predators that could threaten lives, especially of children. Such burning was a defensive measure and in later times would apply not only to predatory animals, but also to human predators. In areas where nut-bearing trees grew, burning the leaves and underbrush exposed the nuts, allowing quicker and more complete gathering. Humans thereby increased their chances for success in competing with animals for this valuable food. These methods continued to be used by southeastern Indians thousands of years later (Catseby 1974, Hudson 1976, Mooney 1900, Walthall 1980).

Changes in climate and vegetation altered wildlife habitats and perhaps caused rarity or extinction of big game like mammoths, horses, and mastodons. In some areas, southeastern Indians began shifting their hunting activities toward animals that remained in the Southeast. The extinction or rarity of big game species appears evident by 10,000 years BP (Graham and Mead 1987, Hester 1960, Martin 1967). The disappearance or dispersion of many species that had existed in Southeastern North America coincides with the end of the Pleistocene (Pielou 1991).

Archaeological evidence indicates that at a very early period, white-tailed deer became the most hunted game species, providing the bulk of the native's protein (Hudson 1976). Even though elk, bison, turkey, and a host of small mammals were taken when available, deer became the target species for management. The reproductive rate of deer was better than that of most other large animals left in the Southeast at the end of the Ice Age. The favorable response of white-tailed deer to a changing ecosystem during the glacial retreat surely did not go unnoticed. As a result, it did not take long for the natives to develop exploitive strategies to take large numbers of deer. Deer populations are not self-regulated. Instead, their numbers rise and fall sharply with fluctuations in their food supply, a key factor recognized by the natives in gaining control over their hunting environment (Hartley 1977).

Other than during the rutting season, it is difficult to approach deer. Bucks are distracted and relax their usual defenses during rut, which occurs in the Southeast from late September through November. Also in the fall, deer are attracted to oak forests to feed on acorns; the natives surely recognized that deer reached their optimal weight at this time (Hudson 1976).

If mesic climax forest with sparse herbaceous understory had dominated the landscape, as has been suggested by some, the low browse potential would have supported only sparse and scattered deer populations. Oaks would have been less abundant, which would have reduced a major food source for deer and other game. Since both deer and oaks were important in the native's diet, it was beneficial to enhance the environment for these species and produce predictable environments.

Fire also created prime habitat for turkeys because of increased insect availability and plants that produce soft fruit or acorns. An interspersion of grassy, permanent forest openings in relatively open forest increases turkey populations (Blackburn and others 1975, Davis 1976). In addition, bear, elk, bison, and a host of smaller mammals benefited from fire regimes that increased oaks and produced an open landscape bearing nuts, fruits, and berries (Bendell 1974). The result of this vegetation manipulation by humans created habitat that was conducive to large deer herds. Thousands of years later, Europeans noted the large deer herds. Historical records indicate that deer herds contained as many as 200 animals—a stark contrast to present herds.

The 2,000 years of American Indian burning during the Clovis and Late Paleo Period developed vegetative patterns that would dominate the Southeast for the next 10,000 years. Thousands of years of burning created a landscape that was conducive to frequent, low-intensity fires. These burning regimes produced a mosaic of open forest with savannas, prairies, and a great abundance of herbaceous vegetation and increased the vigor of the ecosystem by releasing nutrients from vegetation to be recycled through the ecosystem (Barden 1997, Bonnichsen and others 1987, De Vorsey 1971, Lefler 1967, Rostlund 1957).

The Holocene Epoch (10,000 Years BP To Present)

Although the glaciers would not totally disappear for another 3,500 years, the year 10,000 BP ended the Pleistocene Epoch, or Ice Age. It is believed the Pleistocene Epoch lasted approximately 2 million years with four major glacial periods. The last glacial period, the Wisconsin, lasted

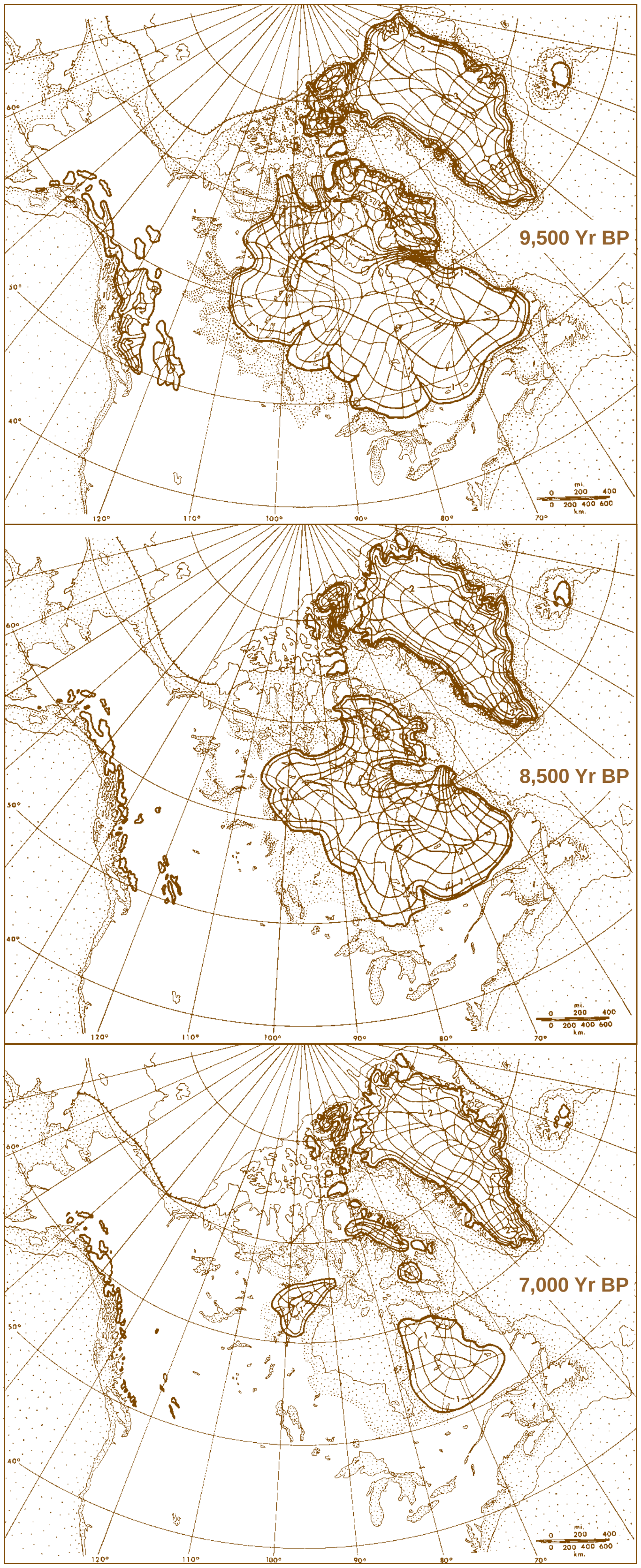


Figure 24.11—Demise of glaciers 9,500 to 7,000 yr BP (Hughes 1987).

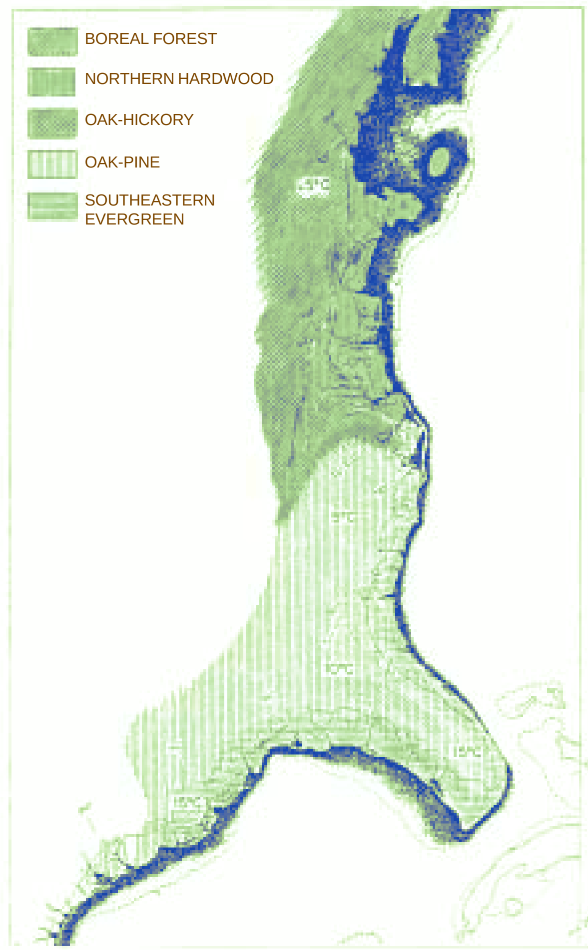


Figure 24.12—Forest types for 9,500 yr BP. Temperatures have risen and precipitation increased due to glacial retreat. However, sea level, river systems, and water tables are still low. Forest species remain south of modern assemblages, and the continuing dry climate produces open forests, evinced by the oak, southern pines, and hickory, which dominate most of the Southeast. Southern pine dispersion and proliferation is attributed to climatic disturbances, arid climate, and natural and native fires (modified Edwards and Merrill 1977).

approximately 100,000 years. The new geologic period, the Holocene Epoch, is an interglacial period and continues today. We are over halfway through our interglacial period that began about 10,000 years ago (Pielou 1991).

An accelerated warming trend began around 9,500 years BP and reached maximum temperatures between 7,500 to 5,000 years BP. Temperatures during this period were warmer than at any time since (Pielou 1991). Higher temperatures melted the remnants of the glaciers in Canada, and the massive ice sheet east of Hudson Bay disappeared around 6,500 years BP (Hughes 1987) (fig. 24.11).

Due to the west-to-east retreat of the glacier, maximum temperatures were reached in Western North America earlier than in the East. Warm air penetrated northwestern regions, allowing trees to grow farther north than they do today. By 10,000 years BP, trees were growing in today's tundra. After 6,500 years BP, the glacier disappeared in eastern Canada, and tree species began moving north into the Hudson Bay area around 3,500 years BP. The northern forest limit then was 175 miles north of the present forest edge. This broad expanse of woodland reverted to tundra as temperatures declined since then. This warming period (7,500 to 5,000 years BP) is referred to by a variety of names, including hypsithermal, Altithermal, xerothermic, or the Climatic Optimum (Pielou 1991).

The melting glaciers during the hypsithermal caused sea levels to rise, reaching present levels around 5,000 years BP. Across North America the increased warmth also dramatically affected tree species composition and distribution, reshuffling wildlife habitats and species (Edwards and Merrill 1977, Pielou 1991).

Vegetation Changes in the Southeast (the Early Holocene 9,500 to 7,500 Years BP)

Oak species already dominated the forest of the middle and lower Southeastern United States by 9,500 years BP; they have continued to dominate until present times. Hickories also were important. Southern pines were increasing and would later become a major component of the southeastern forest (Watts 1983). As boreal tree species migrated north, oaks and hickories became dominant in the upper South, extending into Virginia and Kentucky (Delcourt and others 1999, Edwards and Merrill 1977, Watts 1980) (fig. 24.12).

Southeastern coastal plant communities were probably unstable due to changing sea levels. Sea levels were constantly advancing on the land as the glacier melted. Pollen data indicate increasing presence of southern pine on the Coastal Plain. Disturbance, due to climatic instability, created open areas favorable for pine regeneration (Edwards and Merrill 1977, Spurr and Barnes 1973, Watts 1980).

The Southern Appalachians were also undergoing environmental changes. Increasing temperature shifted boreal spruce and fir to higher elevations, while lower elevations were occupied by mixed hardwoods species, with oaks as the dominant component (Delcourt and Delcourt 1985, Watts 1983). Mountainsides were eroding due to dying vegetation, resulting from unstable climatic conditions. Sediment from this erosive period was deposited in our modern floodplains (Chapman 1985).

The land area of Florida shrunk as the sea level rose. Fresh water was limited because water tables were still very low (Watts 1971). The southeastern climate was becoming warmer but remained dry until about 8,500 years BP when precipitation increased. Oaks were dominant as they had been during the Ice Age. Vegetation was composed of scrub oak, with increasing incidence of southern pines (Davis 1983, Delcourt and Delcourt 1984, Edwards and Merrill 1977, Milanovich and Fairbanks 1980, Watts 1983). As water tables stabilized by 5,000 years BP, forests assumed modern characteristics.

Unstable plant communities characterized the period of warming and deglaciation. Tree species were migrating from refuges occupied during the Ice Age. Some species moved fairly rapidly, while others migrated much more slowly (Davis 1983). Along with the changing vegetation was an increase in the frequency of fire, which is demonstrated by increased amounts of charcoal in pollen profiles (Delcourt 1985, Delcourt and others 1999, Watts 1980) (fig. 24.7). Fires were both natural and human-caused, but our ancestors were probably the predominant source of ignition that resulted in the increased fire frequency during selected seasons (Delcourt 1985, Delcourt and others 1999, Van Lear and Waldrop 1989). The combination of the migration of tree species, high erosion due to dying vegetation, and droughty growing seasons would not have favored a closed-canopy forest.

Oak, pine, and hickory are all relatively shade-intolerant, disturbance species that need openings and sunlight for regeneration. Increasing mean annual precipitation and closed-canopy forest would not have allowed these species to dominate the landscape for thousands of years, as indicated by pollen analyses (Delcourt and Delcourt 1985, Watts 1980). Mesic shade-tolerant species, such as beech and maple, would have dominated forests under a continuous closed-canopy forest. Therefore, the dominance of oak, pine, and hickory in the Southeast was due to frequent disturbance, which created open landscapes favorable for regeneration of shade-intolerant species (Fralish and others 1991). Increased fire frequency and climatic instability would have provided natural settings conducive to the dominance of oak, hickory, and southern pines (Abrams 1992, Brose and Van Lear 1997, Myers and Van Lear 1998).

The annual fires of prehistoric humans established and maintained the open forests, savannas, and prairies observed nearly 10,000 years later by the first European immigrants.

Wildlife Extinctions, Dwarfing, and Redistribution During the Early Holocene

The profound changes that were occurring in vegetation as the glaciers retreated also impacted wildlife species. Some wildlife species that were part of the southeastern Ice Age landscape became extinct or migrated to other regions, or out of North America entirely.

Faunal extinctions toward the end of the last glacial period (Pleistocene) and continuing into the Holocene were not the first wave of extinctions. According to Pielou (1991), at least six waves of extinctions have occurred during the Earth's history. Many of the extinctions have occurred at the end of glacial periods. The sixth wave ranked second in number of species extinctions and occurred at the end of the Pleistocene (Pielou 1991). Estimates of extinctions of mammals and birds between 20,000 to 7,000 years BP are as high as 17 genera (Hester 1960, Steadman and Martin 1984). The greatest numbers of extinctions occurred between 11,000 to 10,000 years BP (Martin 1967).

A number of paleoecologists have developed environmental models that depict rapidly changing ecosystems at the end of the Pleistocene as the cause of wildlife extinctions (Guilday 1982, Guthrie 1990, King and Saunders 1984). Early theories, developed during the mid-1800s, implicated humans in the extinctions at the end of the Pleistocene. However, it was not until Martin's (1967) "overkill theory" that our part in these extinctions was given serious consideration. However, a number of confounding factors, including changes in climate, habitat, and ecosystems, must have contributed to the demise of many species.

Another issue confounding the human "overkill theory" is humankind's long association in Eurasia with many of the species that became extinct at the end of the Pleistocene. Consider the wooly mammoth. Why didn't it disappear much earlier than it did in Eurasia? Clearly, our ancestors were hunting this species well before human entry into the Americas (Graham and Mead 1987, Grayson 1984, Pielou 1991).

Pielou (1991) hypothesized a natural catastrophe that reduced animal populations and from which they never fully recovered. He further contends that the great wave of extinctions at the end of the Pleistocene has not been convincingly explained (Graham and Mead 1987, Lundelius and others 1983, Semken 1983, Steadman and Martin 1984).

Radiocarbon studies suggest that some extinct North American wildlife species may have survived past 10,000 years BP. Semken (1983) proposed that mastodons, sabercats, sloths, dire wolves, horses, peccaries, and mammoths could have existed as late as 6,000 years BP. Support for these later dates came from the discovery of wooly mammoth remains on Wrangel Island north of the Bering Strait in Russia. These remains were radiocarbon dated to 3,700 years BP. A remarkable aspect of these remains was that these mammoths were only 4 feet tall (Vartanyen 1995).

Changing climate and vegetation during the late glacial and early Holocene caused relocation of wildlife. Species that existed in the Southeast during full and late glacial times adjusted to changing habitat. Elk, moose, and grizzly bear, which had migrated into North America about the same time as humans, moved north (Pielou 1991). Caribou migrated north, out of the Southeast, while species such as spectacled bears, llamas, tapirs, capybaras, and flat-headed peccaries migrated south and are now found only in South America. Jaguars may have migrated out of the Southeast much later. Some early colonists from the Carolinas describe a jaguar, in addition to the mountain lion. The use of the word "tyger" can be found in some early literature in the Southeast (Lefler 1967, Logan 1859), and in Latin America the jaguar is known as "el tigre". Porcupines and fishers may have inhabited parts of the Southeast until the 1600s; opossums and armadillos are now expanding their range northward (Semken 1983). The wooly mammoth, the Columbian mammoth, and American mastodon were declining in size prior to extinction. The Pleistocene black bear was the size of a small grizzly (Kurten 1988). Purdue (1989) reported a similar reduction in size for white-tailed deer during the Holocene. Guthrie (1990) documented a decline in the size of bison and also explains the appearance of the modern American bison from the merging of *Bison priscus* and *Bison occidentalis*.

Some animals once thought to have become extinct have been discovered living in small populations. The flat-headed peccary, thought extinct and once a resident of the Southeast, is alive in Paraguay. Also, a species of horse from the Pleistocene believed to be extinct has been found near Tibet. Sightings by natives in the Amazon report a sloth nearly 6 feet tall. Could this be a relative of giant sloth (Pearson 1995)?

The declining size of animals during the Holocene brings up an interesting question. Could the giant armadillo, giant beaver, giant sloth and other species of the Pleistocene have diminished in size to become our modern beaver, armadillo, and sloth?

What caused this dwarfing? Part of the answer may be drastic climatic and vegetation change. Guthrie (1990) postulates an increase in mesic species at the end of the Pleistocene. Mesic species are more toxic to herbivores, and the nutritional level of their foliage is lower. Deterioration of available nutrition would be an important change. Xeric plant species contain higher levels of nutrition, are more palatable, and were more ubiquitous during the drier climate of the Ice Age (Guthrie 1990). The small key deer is the same species as the white-tailed deer but is smaller because of limited nutrition.

Stress may have also been a factor in animal size. Rapidly changing ecosystems combined with human predation may have elevated stress levels in wildlife populations. The combination of changing habitats and human predation probably forced them into less favorable habitat, thereby contributing to nutritional deficits and dwarfing.

The extinction and disappearance of some animals apparently left an impression on the natives of the Southeast. Their stories indicate "things were not always as they are now, and in earlier times many of the large animals and beings of the 'Upper World' came down to live in 'This World.' But 'This World' grew progressively less ideal, and one by one the great animals and beings went back into the 'Upper World'" (Hudson 1976). Perhaps this tale, passed down through generations, relates the extinction process.

As vegetative communities shifted, and changes occurred in wildlife communities at the end of the Pleistocene, humans continued to thrive. Their increasing populations and increasing use of cultural tools and personal ornaments throughout this demanding period testify to their adaptability, ingenuity, and knowledge of the environment.

Early Archaic refers to the southeastern native culture during the early Holocene (Hudson 1976). Migratory hunting and gathering cultures continued into this period. However, there was a greater reliance on deer and smaller game. Spear points declined in size and became side notched. In addition, the number of spear points and tools increased in quantity. Smaller spear points signify a change in hunting technology toward deer and other small game. Archaeologists identify different cultures by the characteristics of spear points. Big Sandy spear points appeared early in the Southeast followed by the Kirk, Palmer, and Stanly spear points (Hudson 1976, Walthall 1980).

There is an apparent change in gathering techniques during this period. Large numbers of stone implements and other tools believed to have been used in the processing of nuts and wild vegetables have been uncovered.

Hypsithermal (7,500 to 5,000 Years BP)

The temperatures of the Hypsithermal peaked between 7,500 to 5,000 years BP and were higher than modern temperatures (fig. 24.13). Warming was experienced worldwide, and the Southeastern United States was no exception. Prairies expanded east of the Mississippi River and grasses increased in abundance, aided by native burning. In pollen samples from Missouri at 7,000 years BP, 85 percent of the species represented were grasses. This proportion of grass species is higher than those recorded for modern prairies (Culberson 1993). Accompanying the expanding prairies east of the Mississippi River were pronghorns and badgers. It is conceivable that the modern bison arrived as well (Culberson 1993, Guilday 1982), while the peccary disappeared from the Southeast (Goodyear and others 1979).

Changing vegetation and rapid deglaciation characterized the hypsithermal. Tree species were migrating from Ice Age refuges. More charcoal is mixed with pollen data due to increased burning by humans. Pines and oaks increase on the southeastern landscape (Delcourt and Delcourt 1985, Watts 1980). Only extensive openings and frequent disturbance from natural and native activities (burning, clearing stream bottoms, and gathering firewood) could explain the increase in pines.

During the hypsithermal, study sites in the Shenandoah, Potomac, and Savannah River Valleys indicated subdued flooding intervals. The data would indicate that the dry conditions were occasionally interrupted by wet intervals, which caused increased sedimentation at some locations. Evidence from some places in the Southeast would indicate oscillating periods of precipitation and temperature during periods of the hypsithermal. However, there is no indication of the season in which the precipitation fell. It is clear that the climate was generally drier and hotter during this period and that overall precipitation was low (Blanton and Sassaman 1989). Pollen data indicate that extraordinary vegetation changes occurred over large areas of the Southeast. Compounding the hotter, drier climate was the still lowered water table and lower sea levels as a result of incomplete thawing of the glaciers (Watts 1971).

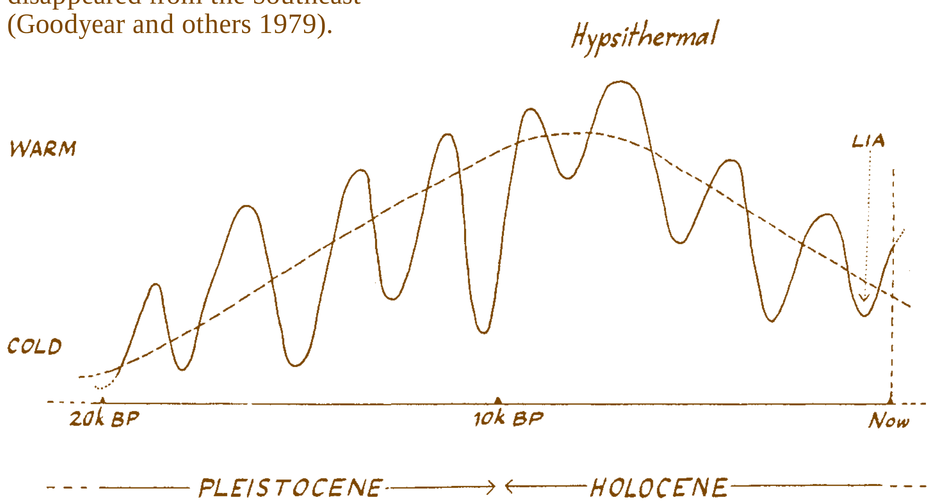


Figure 24.13—Rising temperatures after 7,500 yr BP (hypsithermal) melted the remnant Laurentide Ice Sheet by 6,500 yr BP. Trees reached the Hudson Bay in Canada, where treeless tundra exists today. After 5,000 yr BP, melting glaciers elevated oceans to present sea level. A cooling trend following the hypsithermal eventually led to the little ice age between 1400 and 1880 (modified Pielou 1991).

The Middle Archaic Period differs from the Early Archaic Period due to the continued climatic warming as the hypsithermal progressed. The Morrow Mountain and Guilford cultures were present during the Middle Archaic Period. Archaeological sites indicate a proliferation of Morrow Mountain spear points during this time (Walthall 1980). Food may have been less predictable, elevating competition for resources. Artifacts from these cultures were more crudely made; and settlement sites were small and scattered, possibly due to more frequent relocation resulting from resource scarcity or lack of predictability. However, in the face of severe climatic changes, native populations increased and territories became more defined.

Archaeologists have uncovered evidence of increased external and internal conflict at Kentucky Knoll in Kentucky, the Eva site in Tennessee, and several sites in Alabama. Most conflicts centered around riverine shell-gathering and fishing sites (Walthall 1980). Human activities in coastal areas of the Southeast are poorly documented during this time, possibly due to unstable coastal ecosystems and rising oceans. Subsistence activities appear to be the same as in earlier archaic people. Scattered and scarce resources and increased human populations may have increased conflict between groups.

The Cooling Trend (5,000 to 120 Years BP)

By 5,000 years BP, a global cooling trend caused a major retraction of vegetation communities to their modern locations and halted rising sea levels. The wetlands of the Southeast stabilized at this time and would slowly develop into our present wetland communities. The cooling trend would culminate in a period known as the Little Ice Age, 600 to 120 years BP (1400 to 1880). This event caused a minor retraction and set the stage for modern plant assemblages (Davis 1983).

Oak and pine were dominant over most of the Southeast, due mainly to human activities and other natural disturbances. Native burning regimes increased populations, and native agriculture began to shape the landscape witnessed by the first European immigrants.

Figure 24.14—Meso-America: dashed brown lines mark the boundaries of the Meso-American cultures where complex societies began to develop as early as 4,500 yr BP. Domestication of certain plants, particularly maize, led to sophisticated agricultural systems. By 1500, there may have been 10 million people in this region (modified from Smith 1996).

Following the high temperatures of the hypsithermal, global cooling and the trend toward stable vegetation communities also created a cultural change in the Southeast. This archaeological period is known as the Late Archaic Period (5,000 to 2,800 years BP). The climate and vegetation were similar to their modern equivalents. Population markedly increased and settlements stabilized. As riverine ecosystems reached modern stability, settlements became closely tied to these areas. Mussel gathering and fishing increased, while hunting and gathering followed earlier patterns. There was a great increase in material culture associated with the sedentary way of life. Large steatite and sandstone bowls, increased chipped-stone, ground stone, bone and antler implements, and personal ornaments indicate a developing culture (Goodyear and others 1979, Hudson 1976, Walthall 1980). The bow and arrow were introduced to the Southeast from the Midwest, and even though it did not change subsistence activities, it was a technological advance. Around 4,500 years BP the first pottery appears. It was invented in Florida and South Carolina at about the same time. The invention of pottery reflects the trend away from a more nomadic culture.

A Late Archaic culture known as the Savannah River culture dominated most of the Southeast. What is important about this culture is the increased utilization of floodplains throughout the region. Fire continued to be used to attract or drive game; and after 4,500 years BP, fire was applied to clear floodplain vegetation. Pollen cores taken at a variety of sites in the Southeast indicate increased wood charcoal and early successional herbaceous and tree species (Delcourt and Delcourt 1985). Annual clearing of floodplains was necessary to cultivate important plants, such as squash, gourds, sunflower, sumpweed, and chenopodium (Hudson 1976). Floodplains were cleared to accommodate growing native settlements. Extensive areas of open land, a defensive scheme for protection from unfriendly tribes, surrounded expanded settlements. Higher populations required more firewood, increasing demands on surrounding forests and further enlarging forest clearings.

Larger populations are associated with an increase in social and political structure. These processes culminated in a new cultural period, the Woodland period.

Woodland Culture (2,800 to 1,300 Years BP)

Widespread pottery making, horticulture, and semipermanent settlements mark the Woodland culture. Hunting and gathering methods remained traditional with one major change—the use of the bow and arrow. This tool improved deer harvesting. Arrowheads representative of this period are found throughout the Southeast. Yadkin points were widespread in the region early. Other styles, such as Madison, Santa Fe, Scallorn, and Agee, followed the Yadkin points.

A small-eared form of maize was cultivated from 2,200 to about 1,600 years BP but disappeared because of global cooling. Populations continued to grow, increasing tribal identity, and indicating stronger socio-political systems than in the past (Hudson 1976). Trade between peaceful tribes flourished throughout the Southeast and developed with the larger civilizations in Mesoamerica (fig. 24.14). As Mesoamerican influence gradually displaced Woodland cultures over large areas of the Southeast, the Mississippian culture emerged. However, Woodland cultures continued in Virginia and most of North Carolina. Much of Kentucky became uninhabited around the first century (2,000 years BP) due to migration of tribes to the east and west as a result of aggressive pressure from Algonquian Tribes from the north (Merrell 1982).

Mississippian Culture (1,300 to 400 Years BP)

The cultivation of the tropical maize, flint corn, and beans along the Mississippi River and in the Gulf States marks the beginning of the Mississippian culture. This culture became fully developed in the Southeast around 1,300 years BP and continued until the arrival of Europeans. The adopted intensive agricultural practices from Mesoamerica influenced the landscape in the Southeast dramatically. Large native populations developed in much of the lower South because of the more sophisticated agricultural system produced more food. Without draft animals or plows, agriculture with stone or wood implements was limited to the tillable soils of floodplains, where spring flooding helped renew soil fertility. Agricultural fields were cleared first by girdling trees and then burning the area. The ashes acted as fertilizer (Swanton 1946). Stumps were also removed over time and in the spring old agricultural debris was burned off before planting (Doolittle 1992). When soil fertility declined from cultivation, fields lay fallow but were burned annually to maintain their open condition for future agricultural use. Most of the cultivatable floodplains of the Southeast were cleared of forest and managed in this way (Doolittle 1992, Hudson 1976).

All over the Southeast, land was cleared for large villages, hamlets, agricultural fields, and groves of fruit-bearing trees. In addition, towns moved every few decades because of soil and firewood depletion. Over time, new towns were built on old town sites, which were kept open by annual burning (Hudson 1976).

Clearing floodplains and upper terraces for agriculture and village sites across the South increased as the Mississippian culture spread. Central towns covered hundreds of acres and included expansive plazas and religious centers. Central towns were dominated by extensive public works of truncated mounds topped by temples. One such town, Cahokia, near St. Louis, MO, is estimated to have had a population of nearly 50,000. It was abandoned when firewood and soil were depleted.

There were large organized political centers, or chiefdoms, such as Cahokia, scattered throughout the Southeast. These chiefdoms were similar to city-states and demanded tribute from surrounding vassal tribes. They also waged war and competed with other chiefdoms to secure hunting and agricultural lands to support their large and growing populations. The successful Mississippian culture spread across the Southeast, up the Mississippi River Valley around 900, and then east into South Carolina around 1100 (fig. 24.15). Native populations in the Southeast increased dramatically during this period, and by 1500 it is estimated that 1.5 to 2 million people lived in the Southeast (Dobyns 1983). These chiefdoms were still in place to receive the first Spanish explorers in the 1500s (Goodyear and others 1979, Hudson 1976, Walthall 1980, Ward and Davis 1999). Old World diseases introduced by the Spanish in the early 1500s decimated the American Indian populations of the Southeast. Around

Figure 24.15—Mississippian cultural areas and some important chiefdoms [note direction of expansion (modified from Hudson 1976)].

1600 the Mississippian culture collapsed (Smith 1987).

The Native Ecosystem

For a minimum of 12,000 years, American Indians had been skillfully manipulating the environment, primarily with fire. Human activity was unique during each cultural period, and books could be written on the various periods. The landscapes that the first Europeans encountered were not undisturbed, dense forests as many people today envision. Knowledgeable humans skillfully modified the landscapes to support a population numbering in the millions at the time of European contact. Pollen analysis and historical eyewitness accounts depict a disturbed landscape consisting of a mosaic of open and uneven-aged forests, native settlements, agricultural land, and prairies, which were the direct result of American Indian activity and natural disturbances.

During the long duration of human history in the Americas, the natives developed intimate understanding of the land, forest, plants, and animals. They domesticated plants that are still widely used in agriculture throughout the world. Hudson (1976) estimates that southeastern Indians may have used as many as 500 species of plants for medicinal purposes and that they were successful for treating medical problems. The natives had developed food procurement methods based on seasonality of resources and planned their societies around knowledge of resource availability. Continuous and intimate observations of natural cycles allowed them to understand the complex workings of their ecosystems. Natives were well aware of land management activities that produced abundant fruits, nuts, and wildlife forage in specific locales.

Biological Evidence for Native Burning

There is ample biological evidence to corroborate written historical records by early Europeans that describe the disturbed southeastern landscapes and American Indian's widespread use of fire. The unambiguous dominance of oak, pine, and hickory in the pollen record for thousands of years confirms the presence of uninterrupted fire-disturbed forest ecosystems in the Southeast. Fralish and others (1991) compared the characteristics of presettlement forests to existing old growth forest remnants in the same area using witness trees of an 1806-07 land survey in the Southeast. He found that trees in presettlement forests were more widely spaced and were of larger diameter than trees in existing old growth stands. On dry ridgetops, presettlement trees were shorter with wider crowns, whereas existing old growth trees are taller with smaller crowns due to crowding. Oak and hickory dominated presettlement forests; they are being succeeded by mesic shade-tolerant species in existing old growth. Fire-sensitive redcedar is more prevalent in existing old growth than it was in presettlement forests. This study supports the premise of fire-disturbed presettlement forests dominated by oak and hickory or pines on an open landscape of more widely spaced trees.

The vast longleaf pine ecosystem throughout the southeastern Coastal Plain furnishes additional support for the premise of widespread use of frequent fire by southeastern natives. The longleaf pine ecosystem ranged from Virginia's southeastern Coastal Plain across the eastern and Gulf Coastal Plains to eastern Texas (Landers and others 1995). This ecosystem was distinguished by widely spaced trees, which created an open, park-like pine barren (fig. 24.16). The large expanse of the longleaf pine ecosystem was composed of even-aged and multi-aged mosaics of forest, woodland, and savanna, with a diverse, low ground cover dominated by bunch grasses. Understory hardwoods and shrubs occupied wet areas that did not burn frequently. Longleaf pine is the key tree species in this complex, fire-dependent ecosystem. Without frequent fire, other species slowly dominate these stands (Landers and others 1995). This ecosystem originated after 9,500 years BP as a result of native burning, which created an ecosystem that also encouraged natural lightening fires, due to the nature of the vegetation community.

Species diversity in these savannas is the highest reported in North America (Westhoff 1983). Burned areas contain seven times more plants valuable to wildlife than unburned area. Fire in these ecosystems substantially increases protein content, nutrients, and palatability of forage (Komarek 1983). Longleaf pine seeds are also an excellent wildlife food. It is not difficult to understand the motivations for developing these prime ecosystems for food procurement.

The Native Ecosystem as Witnessed by the Early Europeans

When Europeans arrived, the landscape of the Southeast was a mosaic of open pine and hardwood woodlands, prairies, meadows, and oak or pine savannas in a variety of

Figure 24.16—A view of the longleaf pine-wire grass ecosystem.

HISTORY

successional forest stages. In addition to American Indian influence on vegetation, natural events, such as hurricanes, thunderstorms, ice storms, insects, and diseases, constantly disturbed the vegetation of the Southeast (Conzen 1990, Myers and Van Lear 1998). Oaks, southern pines, and hickories were dominant tree species almost everywhere. Pine barrens or savannas with scattered oaks dominated large areas of the Coastal Plain. Oak, pine, and hickory forests were dominant in the upland areas across the middle and upper South. The Appalachian Summit was also dominated by oaks but had a mixture of other important hardwoods, such as American chestnut, hickories, maples, poplars, and residual boreal species (Delcourt and Delcourt 1984, 1985; Watts 1980, 1983).

This landscape supported a diversity and abundance of wildlife, such as deer, turkey, bear, elk, bison, wolves, mountain lions, and myriad smaller mammals. Nonmigratory and migratory birds were abundant throughout the region. Early writers talked about the abundance of passenger pigeons, where flocks in flight would literally block out the sun. Beaver impoundments and other wet areas supported mesic trees, shrubs, and a diversity of hydric plants, such as sedges, rushes, and cattails, while providing habitat for waterfowl, other birds, mammals, and reptiles. Wetlands in the Coastal Plain also supported stands of baldcypress, swamp tupelo, water tupelo, sweetgum, along with oaks and other hardwoods.

Early Spanish explorers remarked about the open nature of forests, prairies, and savannas, and the extensive cultivated fields and groves of fruit-bearing trees extending for miles over the landscape. The settlers were in consensus about the ease of travel through the forest even on horseback and were able to move large groups of people, horses, and livestock easily through the landscape (Doolittle 1992, Gremillion 1987).

English settlers and explorers confirmed the Spanish accounts with similar descriptions of the landscape. They also witnessed burning by the natives. As one English settler wrote in 1630, on approaching the Delaware coast, “the land was smelt before it was seen”, referring to the smell of smoke (Cowdrey 1983). This settler would remark on the openness of the forests, and what this settler saw and “smelt” was the typical scene all over the Southeast (Barden 1997, Byrd 1928, Cumming 1958, Hartley 1977, Lefler 1967, Leyburn 1962, Logan 1859, Platt and Brantley 1997, Rostlund 1957).

Those unfamiliar with the rapid development of dense understories in unburned forests of the South would soon appreciate the motivation of the natives to manage their land with fire. This is true for every southern ecosystem from the coast to the mountains. In the absence of fire, any means of travel becomes impossible as small hardwoods combine with shrubs to create dense, impassable thickets.

Early writers ignored the eyewitness accounts and opted for a more romanticized description of this dynamic landscape, describing a pristine closed canopy forest where a squirrel could travel from the Atlantic Coast to the Mississippi River without touching the ground. This romantic description is a myth (Buckner 1983). An equally romanticized picture was also painted of the natives.

Decline of Native Populations

When Christopher Columbus’ three ships anchored off the coast of San Salvador, little did anyone, European or native, realize the magnitude of the impacts of the Old World meeting the New. The Spanish, who sponsored Columbus, were initially attracted to the wealth of the large complex societies of Mesoamerica. Rumors led the Spanish to believe that similar societies existed in the Southeast. Early in the 1500s, Spanish expeditions probed deep into the Southeast.

Some of the first estimates of pre-European native populations in the Southeast occurred in the early 1900s (Kroeber 1939). They were based on early English accounts, following dramatic population declines that resulted in the low estimates. Pre-European native populations of the Southeast were substantial. More recent estimates such as Dobyns (1983), have postulated larger populations not only for the Southeast, but also for the entire Western Hemisphere. Dobyns (1983) estimates native populations in the Southeast at 1.5 to 2 million people at 1500. Today population estimates are based on greater understanding of the impacts of epidemics along with the increased knowledge of the complex civilizations of the Mississippian chiefdoms.

European expeditions introduced Old World diseases that would shake the foundations of every American Indian culture in the Western Hemisphere. Of all the organisms Europeans carried to America, none were more devastating to southeastern Natives than Old World diseases (Hudson 1976, Smith 1987).

Before 1492, America was not disease free, but native diseases derived from the age-old human problems of population density, diet, and sanitation. During the period of European contact, disease-related mortality rose to levels previously unknown; and the impact of these diseases was swift and harsh. In areas of the Caribbean, entire native populations were erased. These epidemic diseases were transported from the Caribbean to Mexico and Central America and may have preceded the arrival of the Spanish in these areas (Lovell 1992, Verano and Ubelaker 1992). Epidemic diseases were introduced to the natives of the Southeast at about the same time (Thornton and others 1992). During the 100 years of Spanish exploration, disease decimated the dominant Mississippian cultures of the Southeast and resulted in their collapse by 1600 (Smith 1987).

European diseases not only depopulated American Indian cultures (depopulation is estimated as high as 90 to 95 percent), they disrupted the social structure of native societies. As in all epidemics, mortality was disproportionably greater among the young and old. Loss of the younger generation had profound effects on the integrity of American Indian societies. The loss of manpower created difficulties maintaining agricultural systems and fire regimes. Loss of the elderly eliminated a storehouse of knowledge, tradition, and custom (Hartley 1977, Hudson 1976, Smith 1987).

The arrival of the English continued the epidemic diseases and decimation of American Indians for at least another century. English trade with the natives lured them into dependence on the European fur market for European goods, which in turn diminished the traditional reasons for hunting, while devastating wildlife populations

(Hartley 1977, Hudson 1976, Smith 1987). As the fire regimes and agricultural systems gradually eroded, the appearance of the land began to change. Uncontrolled vegetation began to form an unbroken shroud. The extensive canelands witnessed by English settlers as they pushed inland were signs that the thousands-of-years-old fire ecosystems created by the natives were in decline (Platt and Brantley 1997).

Potential Forest Vegetation?

E.L. Braun (1950) developed a generalized map of potential major modern forest types for the Eastern United States (fig. 24.2). The map was developed from surveys to project potential forest species compositions that best characterize the eastern forest region. Braun's classic study is still an important standard for vegetation maps today. Paleoecologists have produced generalized vegetation maps for periods in the past. Delcourt and Delcourt (1984) produced a vegetation map for dominant plant species occurring 18,000 years ago (fig. 24.1). When Braun's modern vegetation map is compared to the Delcourts' map of vegetation, it is evident that dramatic changes have occurred. The presence of glaciers 18,000 years ago, and their absence now, account for much of the difference.

Eighteen thousand years ago the southeastern landscape was powerfully influenced by a massive glacial ice sheet, which created an unusually dry climate. This dry climate limited tree distribution and growth and was conducive to frequent and widespread fire. The glacier's subsequent retreat resulted in extreme continental temperatures, changing sea levels, and disrupted vegetation and wildlife communities. The arrival of humans about 12,000 years BP and their use of fire in the Americas complemented the natural fire regimes. The dominance of oak, hickory, and southern pines throughout much of the Southeast is due to extensive disturbance by humans and nature for millennia. In fact, the vegetation composition and distribution, which complemented the diversity and abundance of wildlife at the time of European contact, was primarily the result of American Indian management of southern landscapes with frequent burning for over 12,000 years.

Because of fire exclusion during much of the recent past and the public's desire for undisturbed forests, unprecedented changes in vegetation composition and distribution are occurring across the Southeast. Oaks, hickories, and pines can survive for hundreds of years in the overstory, but will they remain dominant in our forests without fire? Oaks do not regenerate in extant oak stands on high-quality sites; rather, they convert to more shade-tolerant species (Loftis and McGee 1993). In the absence of disturbance, oaks are not able to regenerate and will not maintain their historical dominance (Abrams 1992, Brose and Van Lear 1998, Loftis and McGee 1993). In the Southern Appalachians, cove forests and upper ridges are increasingly dominated by dense understories of shade-tolerant shrub species, such as rhododendron and mountain laurel, which out compete shade-intolerant oaks, hickories, and southern pines (Baker and Van Lear 1998, Elliot and Hewitt 1997, Hedman and Van Lear 1995). Without disturbance, beech, maples, and other shade tolerant species will gradually dominate southern forests. In the southern Coastal Plain, the once dominant fire-dependent longleaf pine type now occupies less than 3 percent of its original range (Landers and others 1995).

The "potential" or "natural" vegetation map developed by Braun (1950) is a reflection of the Clementsian model of forest succession that dominated ecological thought until the mid-1950s. This model considered disturbance as a relatively unimportant event in the long-term order. However, ecologists now recognize the importance of disturbance. It has been disturbance, repeated over and over for thousands of years, on different temporal and spatial scales that led to the dominance of oaks, hickories, and southern pines in southeastern landscapes and provided the habitats that supported diverse and abundant wildlife populations.

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The southern forest resource assessment provides a comprehensive analysis of the history, status, and likely future of forests in the Southern United States. Twenty-three chapters address questions regarding social/economic systems, terrestrial ecosystems, water and aquatic ecosystems, forest health, and timber management; 2 additional chapters provide a background on history and fire. Each chapter surveys pertinent literature and data, assesses conditions, identifies research needs, and examines the implications for southern forests and the benefits that they provide.

Keywords: Conservation, forest sustainability, integrated assessment.