Introduction to Eastern North American Forests

Early Americans found a land of plenty when they arrived in eastern North America by way of the Bering Land Bridge 15,000 years ago. These original Americans were successful hunters and used diverse strategies and tools to harvest the Pleistocene megafauna of mammoths and mastodons. The early people established settlements in the southwestern region where they used timber for fuel and structural support in the canyon dwellings. Evidence suggests southwestern Americans traveled great distances to harvest pine and other desirable products.

Early Americans ventured east of the Rocky Mountains and Mississippi River 10,000 years ago. As the large paleomammals declined in the west, migration to the east became necessary to feed and fuel the expanding human presence. Diverse hunting skills were soon augmented with techniques to manage and manipulate the landscape. Trees were girdled and burned to remove forest, open land for agriculture, and manage wildlife. The use of fire discouraged the growth of beech and maple forests, but likely encouraged more fire resistant species such as oak, pine, and hickory. The first agricultural crops included maize, squash, sunflowers, barley, and a little known grain called Chenopodia. Strawberries, walnuts, chestnuts, and native grapes were gathered from native vegetation. Milkweed, ragweed, and nettles were among the first weedy plants escaping the prairies and following the early Americans eastward. These species provided early eastern Americans with important fibers for woven products.

Native American society was widespread in the east before 1000 A.D.

When Columbus arrived in 1492, the forests were still vast and plentiful. PaleoAmericans had opened agricultural habitat through their use of fire along fertile river valleys. It is likely that some prairie plants (goldenrod, milkweed, and grasses) had hitchhiked with PaleoAmericans across the western plains into forest openings in the east. But for the most part, Columbus and the following hordes of Europeans witnessed an ancient forest with abundant resources to fuel a human population explosion.

When Europeans set foot on the New England coast they found a sea of forests. At first the new landscape was foreign and frightening. The forest of Europe had after all been removed and utilized for centuries before their departure. The new forested surroundings of North America were unfamiliar, dark, humid, eerie, and mysterious. Early European settlers worshiped openness and light which was far more familiar. Settlers open patches in the forest to establish agriculture and dwellings. In short time, settlers learned that the forest was full of food and supplies to sustain the developing new world.

The woodlands were full of turkey, grouse, deer, rabbit, and squirrel. Wolves and mountain lions roamed the landscape and keep the population of prey from exceeding the capacity of the land. Native fish were plentiful and salmon still migrated from the Atlantic into rivers and streams by the millions. Eagles, osprey, and otters shared the lakes, rivers, and streams for the bounty of food, protection, and shelter. Beavers manicured their share of the water and forest that created new habitats for other birds and mammals. The forest plants provided nuts, berries, and materials to aide in the hunt. The forest animals provided an abundance of furs and hides for clothing and shelter. These ancient forests were rich in biological diversity and a seemingly endless supply of resources used for human survival.

The abundant resources of North America improved the health and standards of living for colonizing Europeans. Water was cleansed by the forest and ran abundantly in unpolluted streams and rivers. Turkey, deer, grouse and fish provided an abundance of dietary protein. Huckleberries, blackberries, blueberries, walnuts, hickory nuts, and white oak acorns yielded
seasonal foods. Oak and chestnut provided lumber to build shelters. Deer, bear, otter, and beaver pelts were used for jackets and blankets. Wood fueled the stove and gave warmth to survive long winter months. European settlers learned new tricks such as making maple syrup, burning forests to manage and capture prey, and using fish as an agricultural fertilizer. These and many other skills traded between American and European societies made life easier and farming more prosperous. Although the first colonies at Roanoke and Jamestown initially struggled to survive, the combination of human skills and natural resources provided the impetus to drive the human population explosion in North America.

The abundant forest resources provided surpluses for trade with Europe during the 18th and 19th centuries. Nuts and game could be shipped overseas as well as timber for building, shingles for roofs and siding, and potash for soap and gunpowder. Giant white pines were harvested for ship masts, the generous flow of turpentine and resin from southern and coastal pinelands provided the products to waterproof and preserve wooden ships and cloth sails. Pitch and tar was manufactured by burning pines in earthen furnaces. Maize, tobacco, peanuts, squash and other crops were introduced to the Old World from the Americas. The fur trade with Europe was booming. The forest provided, the settlers took and Europe reaped the benefits. Europeans introduced disease, invasive weeds, and heavily cut the forest. More than 90% of the eastern landscape was forested until 1600. In the next 300 years, more than 60% of the eastern forest would disappear. Clearing of forests paved the way for the expansion of agriculture. Charcoal and timber fueled smelting operations as the American landscape yielded an abundance of iron ore. Lumber provided the structural support for mineral and coal mines and new resources were discovered. Timber was quickly harvested from every swamp and mountain side for construction and paper. Even wood ash was packaged and shipped to Europe to make soaps. Bark provided the tannins used to tan and preserve leather hides. It could be successfully argued that wood in the 19th century was the oil of the 20th century. Forest products drove the industrial revolution of North America.

As the human population grew, so did the demands for wood. Sawmills were popping up everywhere that rivers could deliver the rafts of logs from upstream forests. In New York alone, the number of sawmills increased from 4,321 to 7, 406 between 1825 and 1845. In 1839, New England provided two-thirds of the nation’s lumber. Although total production didn’t decline in the Northeast over the next twenty years, the increase in lumber operations elsewhere increased dramatically so that New England’s share of the market declined to little more than 30%. Small, independently owned sawmills were replaced by larger more efficient steam driven industries. Humans were moving westward and so did the saws. The need for lumber continues to increase as lumber was needed for railroad ties, tresses, bridges, and outposts. The railroads, in turn, opened new areas to forest harvest. By 1900, the combined wealth of coal, iron, and precious metal mining was still far below the wealth generated by harvesting forest products.

The paleoforests of eastern North America were remodeled by European settlers. Impressive ancient forests were whittled to dots on a map. Weeds such as ragweed became widespread. Pollution from coal, wood, and charcoal burning facilities filled the air with soot and novel chemicals new to American woodlands. Without trees in place, the soil dried, organic matter decomposed and nutrient rich sediments began to erode into streams, rivers, and lakes. Water quality declined and humans imposed new selective pressures on the aquatic landscape. Weedy plants from Europe and elsewhere flourished on disturbed agricultural soils. The passenger pigeon, once the most abundant warm-blooded animal on the planet, declined precipitously as hunting and intense ecological pressures increased until our beloved Martha died.
at the Cincinnati Zoo and marked the extinction of another evolutionary novelty. The abundant American chestnut built North America’s industrial rise. This tree species nearly received a fatal blow from an introduced fungus. Fortunately, stump sprouts of this great giant keep the chestnut from extinction in the short term until breeders and genetic engineers can restructure its genes to tolerate the dreadful blight. Naturalists occasionally stumble upon small groves of American chestnut that appear to have survived the blight only to succumb once again within a few years of discovery. Humans arrived, reaped and plundered, burned and hunted, introduced and annihilated. The North American forests would change forever.

The discovery and use of fossil fuels, coal and petroleum released forests from further destruction. Settlers moved westward and eastern agricultural land was abandoned. Remaining farmlands could be farmed more intensively by the development of machinery and fertilizers both outcomes of fossil fuel discovery and use. Although eastern forests are far from recovered, nearly 60% of the modern eastern landscape is forested. Today, one can stand on the high peak in the Adirondacks, on a roadside overlook in the Smoky Mountains, and on Skyline drive in Shenandoah National Park to witness great expanses of recovering forests.

**Modern forests of Eastern North America.** The characteristics and composition of modern North American forests are the result of natural and man-made selective pressures. The blend of tree species in these woodlands depends on their physiological tolerances to the climate, soils, water, sunlight, and wind. No species lives in a void, separate from other organisms. Intense pressures from microbes, fungi, insects, birds, mammals, and competition with similar species. The parasitic plant beech drops survives only where American beech lives. Orchid seed germinate only where the right soil fungi exists. Mourning cloaks and question mark butterflies need their willows. Blue jays shuttle oak and beech seeds out of deciduous forests to open pinelands where the seeds are cached for the winter months. The range of each plant, animal, insect, and fungus depends on its propensity to reproduce, disperse, and germinate in new areas in concert with other organisms. Together these biotic and abiotic features fold upon the landscape to produce varied and diverse forests in eastern North America.

Chance and random sorting also played an important role in creating the different forest communities. Forests composition varies between hillsides, river bottom lands, and point samples within the same geographic area. Chance events of dispersal, fire, fungal composition, animal movements, and winds sorted species like a dealer shuffles and deals cards. Random sorting into and out of glacial refugia constructed maple-basswood, or maple-beech, yellow birch-maple or beech, maple, yellow birch forests. There may be no real biological reason why some assemblages of forests are the way they are.

The climate in eastern North America varies considerably along east-west and north-south transects. Climatic patterns are also influenced by land forms and bodies of water. Eastward moving air masses dry as they pass over western mountains. Thus, much of the central plains and Midwest is dominated by prairies and oak-hickory forests that are tolerant of dry conditions. Winters are cold and dry and summers are warm and humid in the Midwest. Moisture laden air flowing northward from the Gulf of Mexico hydrates the atmosphere to provide sufficient summer rainfall to support the eastern mesophytic forests. Low pressure systems that move northward along the Atlantic coast in the late summer and fall deliver precipitation from the southeast through New England. The southeast experiences hot humid summers and cool moist winters. New England combines the moisture from the Great Lakes, Atlantic and Gulf with northern cold air masses to produce cold winters with abundant snowfall.
Eastern forests are also influenced by latitude. Higher latitudes experience greater annual variation in photoperiod or the relative day and night length than southern latitudes. Southern latitudes are warmer in the winter and summer than northern latitudes. Why are these relationships important? Frost and freeze tolerance restrict the advancement of some forests such as southern pines and oaks in a northward direction. In addition, photoperiod is an important environmental cue that tells plants when to begin growth in the spring, flower, and senescence in the autumn. These processes must be closely coordinated with appropriate growth conditions.

Watertown NY and Columbus GA represent two extreme cities in the eastern deciduous forest that can be used to illustrate the significance of latitude on plants. Watertown rests at 44ºN latitude and will experience day lengths of approximately 15.5 and 9 hours on the summer and winter solstice, respectively. Columbus is located at 32.5ºN latitude and experiences about 14 hrs 15 minutes on the summer solstice and 10 hours on the winter solstices. The last expected frost for Columbus and Watertown is March 21 and May 7. Plant growth free of frost damage may be initiated by a twelve hour photoperiod in Columbus, but would risk the same plant with 45 more days of potential frost in Watertown. This northern city near the transition zone to the boreal forest will also have an extended winter period below freezing. A similar stretch of cold weather in Columbus is unheard of.

Species diversity declines along a northward transect. This relationship holds for forest trees, herbaceous plants, birds, amphibians. This relationship likely holds for fungi, insects and other forms of life. Where Central American forests have a 1000 or more species of trees, this number declines to nearly 200 for the southeastern U.S. and 75 for northern states. The richness of tropical forests is in part due to its antiquity and habitat diversity. Northern forests are heavily influenced by physiological stresses of cold winters and photoperiod variation. In addition, these forests have tracked climatic change through several rounds of glaciation on the North American continent.

At the pinnacle of her famous career, ecologist E. Lucy Braun mapped and defined nine forest types within Eastern North America. This classification scheme has stood the test of time and is still used in ecology classrooms and texts (Figure Braun Classification). The nature of her classification system is heavily influenced by geological formation and latitude/longitude gradients in soil and precipitation patterns.

Lucy’s vegetation map has been revised and redrawn, but many of the patterns described stand true today. A copy of Braun’s book is a must for eastern ecologist. The text describes in great detail the constituent species, hydrology, and soil type of nearly every forest in eastern North America.

Recently, a fire and fuel management study sponsored by the U.S. Department of Agriculture and US Forest Service generated the Potential Natural Vegetation Map (Figure Potential Natural Vegetation Map). This map reflects land forms, climate and soil type that determine the natural climax forest in each region without the influence of disturbance. The PNV was generated using mountains of geological, climatic, and biological data in a computer age. The frequency and likelihood of fires is dependant on the type and accumulation of wood in
the forest. Forests dominated by oak and hickory accumulate organic fuel because the wood of these species is resistant to decomposition. Add pines and their volatile, flammable terpenes to the fuel laden oak-hickory forests and a fire prone ecosystem is created. Basswood, maple, and birch logs decompose quickly and forests dominated by these species are unlikely to burn. Although the PNV map serves a different purpose, it is strikingly similar to the Braun’s vegetation classification.

According to Braun, the center of diversity in the eastern temperate deciduous forest is located the southern Appalachians. The Mixed Mesophytic Forest occurs in a band that swells from northern Alabama and east-central Tennessee northward to West Virginia and western Pennsylvania. This mixed-mesophytic forest supports the greatest diversity of trees, spring ephemerals, and other forbs in eastern North America. Mature forests in this region are tall and old. The forest is well stratified into canopy, subcanopy, and herbaceous perennials. Tulip poplar, sugar maple, American beech, white basswood, and tulip poplar are among the dominant tree species. These forests are well known for their nutrient rich soils and rich humus. There are many unique endemic trees to this region. They include magnolias, pawpaw, dwarf chestnut, and several species trillium and Rhododendron/deciduous azalea.

The rugged terrain and variation in moisture regimes in the southern Appalachians supports a diverse array of forest subtypes in the Mixed Mesophytic Zone. Relicts of ancient boreal forests with red spruce and Fraser fir as well as alpine tundra communities are found at high elevation in the Smoky Mountains and western North Carolina. Cove hardwood forests are the most species rich forest type in the southern Appalachians. Mid-elevation mesophytic forests in Tennessee and North Carolina are tall, humid forests with humus rich soil. White basswood, sugar maple, tulip poplar, Carolina silver bell, yellow birch, bigleaf and cucumber magnolia, and yellow buckeye are a few of the co-dominant species. Understory trees include sassafras, redbud, flowering dogwood, and sourwood. An abundant array of forest perennials and shrubs of rhododendron and deciduous azaleas spread additional beauty along the forest floor. Cove hardwood forests have the greatest diversity of salamander and bird species in eastern North America.

The combination of rugged ancient mountains and abundant moisture spawns a hotbed of biodiversity in the southern Appalachians. More than 150 species of tree reside there as well as more than 10% of earth’s diversity of salamanders. The rugged terrain, ancient forest, moderate conditions, and high humidity have created conditions for adaptation and reproductive isolation in salamanders. This diversity is also matched by many endemic species of plants such as Ocone bells (\textit{Shortia galacifolia}), Buckleya, and numerous forest perennials. Buckleya is an unusual woody shrub that parasitizes hemlock roots only in full sunlight. This unusual combination of growth requirements are found in very few areas of the southern Appalachians and contribute to rarity of Buckleya.

A drier, albeit equally diverse, Oak Chestnut Forest is located along the eastern edge of the southern Appalachians (mountains of North and South Carolina and Virginia). Today these forests are rich in northern red, chestnut, and scarlet oaks. Shagbark and pignut hickory are important species in some areas of the Oak-chestnut forest. Formerly, sixty percent of the forest was dominated by a single species, American chestnut. Chestnut wood was the most valuable lumber in the 18th and 19th century as lumber fueled the growth and expansion of human populations in the east. As one travels along Skyline Drive you can appreciate how the forest has changed. American chestnut is still very common in the form of stump sprouts along roadside cuts and understory trails on dry mountain sides.
The central piedmont regions of Gulf Coast and south Atlantic states boast the Pine Oak Forest between the southern Appalachian foothills and coastal plain. The soil is sandy and the environment is hot, sunny and arid during the summer months. This forest is dominated by a variety of scrub oaks and pines. This zone extends north to southern New Jersey forming the pine barren region. Here as in Virginia and North Carolina, the forest contains pitch, shortleaf, and Virginia pines. Further south and along the Gulf piedmont loblolly and longleaf pine are abundant. Oaks found throughout this region such as willow, turkey, overcup, black jack, post, and southern red oak. Armadillos, red-cockaded woodpeckers and the now extinct Ivory-billed Woodpecker are indicator animals for this forest. Bald cypress, water tupelo forests are typical along rivers throughout this region. The dark swampy forests form the backdrop of southern mysteries in literature and film.

The southern Atlantic coastal plain supports a Broadleaf Evergreen Forest. The Spanish moss draped live, laurel, and willow oaks are perhaps the most famous component of the forest and provide coastal cities with many picturesque parkways and roads. Live oak was a very important timber tree for the ship building industry of the 18th and 19th centuries. Persimmon, pecan, and southern magnolia are important trees common to these southern forests. Evergreen forests of yaupon holly constitute maritime forest along the Atlantic coast.

The Oak Hickory Forest is a transition zone between moist, mesophytic forests of the Appalachians and the dry prairies. This is the dominate forest throughout western Tennessee and Kentucky, through Oklahoma, Missouri, Arkansas, and Texas. Bur oak is a large, vigorous, and statuesque tree in the Midwest oak hickory forests. PaleoAmericans may have had a hand in dispersing the valuable acorns northward in an attempt to provide forage for wild game species. The oak-hickory area possesses a number of endemic tree species such as osage orange or beaud’arc. The softball-sized fruits of osage orange are heavy and dispersed by gravity. Squirrels and small rodents will cart off portions of the fruit to eat and disperse the seeds, but the vast majority of fruits remain close to the parent tree. Some scientists have hypothesized that fruits such as osage orange, and other oak-hickory endemics such as honey locust, and Kentucky coffee tree were once dispersed by large herbivorous mammals (i.e., mammoths and mastodons) that roamed North America.

Northern Hardwood Forests are an extension of the southern mixed mesophytic forest. The composition of the northern forest varies geographically. For example, American beech and basswood are most common form dominate zones in the lower peninsula of Michigan, Indiana, and Ohio. American beech and maple are the most common tree species in western Wisconsin and eastern Minnesota. In the northeast, yellow birch, American beech, and sugar maple share the forest as co-dominant species. Southern species such as sassafras, flowering dogwood, and cucumber magnolia are found along the southern shore of Lakes Erie and Ontario as well as around the Finger Lakes. These bodies of water moderate winter climate and allow these species to persist in this frigid prone region.

The northern hardwood forest is a broad band that stretches from New England, through southern Canada to the northern half of Michigan, Wisconsin, and Minnesota. This forest has a climax of sugar maple, American beech, and yellow birch. Eastern Hemlock and white pine are common conifers. The diversity, antiquity, and endemism of this forest is less than that of the southern mixed mesophytic forest. Nevertheless, some forests of New England and the Adirondacks of New York possess hemlock and yellow birch trees almost 400 years old. It is these species in the north that have demonstrated resiliency and adaptability following a changing climate through many glacial and interglacial periods.
The northern hardwood forest gradually transits into the **Northern Coniferous or Boreal Forest** across New England and the northern Midwest. The boreal forest is North America’s largest intact forest stretching in a broad band from eastern Canada to Alaska. Although some broad-leaved deciduous birches, willows, and poplars, exist here, the boreal forest landscape is dominated by white spruce, black spruce, balsam fir, and pine. The forest is a hiker’s nightmare with a thick tangle of skin piercing branches and uneven hole-filled soil. A thin layer of forest herbs, mosses, and lichen carpet the forest floor. Reminent sof the boreal forest occupy several areas of the United States. Balsam fir and red spruce grace the upper slopes of the Adirondacks and New England. The fragrance of balsam gives the woodlands in these areas welcomes visitors and provided an unforgettable olfactory memory. Black spruce punctuates the wetlands in this region as it is tolerant of severe inundation in cold environments. White spruce and jack pine are more common in Midwestern transitional forests. All of these conifers dominate the landscape in central and northern Canada where winters are cold, dry, and long. The evergreen lifestyle allows these species begin photosynthesis earlier in the spring just as the sun returns and temperatures warm just above freezing. The flexibility of conifer branches assists with shedding snow and bending in blowing winds. To most United States citizens, their greatest, and underappreciated, association with the boreal forest comes from the soft properties of spruce wood that is important commodity in facial tissues and toilet paper.

The text that follows is an introduction to the eastern forests and natural history. Although most if not all of the concepts discussed apply to many aspects of all forest types, many of the examples provided are from eastern deciduous and northern hardwood forests. Our understanding of how the forest functions and operates is based on observation, history, and empirical data. Although the format is general and intended for a diverse audience, the information is based on science. Insight and conclusions from scientific studies are used throughout to augment our understanding of forest function.

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