

II. DISTURBANCE PRIOR TO EUROPEAN SETTLEMENT

Natural Disturbance

The major natural disturbances affecting Massachusetts forests include windstorms, pathogens (insect and diseases), and fire. Evidence of past storms may persist for as long as a thousand years in the pits and mounds often found in our forests,^{8,9} but these microtopographic features offer no information about the frequency, intensity, and distribution of storms, which vary with changing climatic conditions. However, if, as seems likely, storm patterns have remained stable in Massachusetts over the postglacial period, we can infer trends from observations over the past few hundred years.

Two different types of windstorms cause significant damage to Massachusetts forests: tropical storms, or hurricanes; and downbursts, or microbursts—sudden, straight-line winds, often from the northwest, associated with severe thunderstorms and occasionally accompanied by tornadoes. Downburst winds are probably the dominant wind disturbance in the Berkshires and western Massachusetts. They continue east across central Massachusetts and become less important in areas near the coast under the stabilizing influence of maritime winds. While commonly confined to small areas, the potential destructiveness of these winds was demonstrated in July 1995, when hundreds of thousands of acres of forest from the Adirondack region of New York into western Massachusetts were severely damaged by an extremely large and long-lived downburst front.¹⁰

Tropical storms represent the most important wind disturbance in central and eastern Massachusetts. Historical evidence indicates that hurricanes may affect central and eastern areas approximately every hundred years, with the Cape and islands affected more often. The strongest winds in these large, counterclockwise-

rotating storms are on the easterly side, as illustrated by the catastrophic storms of 1815 and 1938. These storms produced the greatest damage on south- and east-facing hillsides while steep north and west slopes were protected from the strongest winds.¹¹ Western exposures and ridges, on the other hand, are prone to selective damage from the more patchily distributed microburst winds associated with severe thunderstorms.

The only strong evidence of pathogenic disturbance in the paleoecological record is the widespread hemlock decline nearly five thousand years ago. The rapidity and extent of this decline, not associated with declines in other species or identifiable climatic change, points to a species-specific pathogen as the cause. Hemlock remained at low population levels for nearly a thousand years. The extent of its eventual recovery differed across the region. At many sites, hemlock gradually approached its predisturbance abundance between a thousand and fifteen hundred years later.¹² At other sites, it never fully regained its former importance, presumably because of competition with recently immigrating species or slight climatic changes over the intervening period. Of course, this event offers many comparisons with the human-transported pathogens (gypsy moth, chestnut blight, hemlock woolly adelgid) that our forests are coping with today.

Fire, like windstorms, probably differed significantly in its impact across Massachusetts as a result of differences in climate, fuel type and abundance (which varies by vegetation type), and ignition sources (lightning and aboriginal human populations). When we look at the impacts of fire, we encounter the earliest strong evidence for human influence on Massachusetts forests. Charcoal in sediment cores indicates that fires were less frequent and therefore less important in the Berkshires than in southeast-



Paths of the major hurricanes that have impacted New England from 1600 to the present are shown on the left. On the right is the damage inflicted on forests in the region by the 1938 hurricane. Approximately three billion board feet of timber were windthrown by the storm, more than six hundred lives were lost, and damage costs exceeded a hundred million dollars.^{14,15}

ern Massachusetts and on Cape Cod.¹³ The droughty, sandy soils of the latter areas supported a highly fire-prone vegetation largely dominated by pitch pine, scrub oak, other oaks, and huckleberry. Pitch pine, like all conifers, contains resins in its needles that make it much more flammable than broadleaf, deciduous trees. Huckleberry, although a broadleaf, deciduous species, also contains resins in its leaves and therefore creates a very flammable understory. At the same time, this type of vegetation is highly fire-adapted. All the oaks, especially scrub oak, are prolific sprouters following injury. Pitch pine is unique among Massachusetts' native conifers in possessing dormant buds beneath the bark and near the base of its trunk that enable the tree to sprout and survive if the main stem is severely damaged by fire. Moreover, the cones of pitch pine tend to be *serotinous*, which means they may remain

closed with seed inside until the heat from a fire triggers an opening mechanism to release the seeds onto the recently burned landscape. Although pitch pines in Massachusetts rarely exhibit this behavior today, it is commonly observed in the frequently burned New Jersey pinelands.

The northern hardwood species—sugar maple, beech, and yellow birch—while capable of sprouting, tend to have thinner bark that provides less protection from understory fires. Hemlock, a major associate in the northern hardwood forest, is also thin-barked as well as slow-growing, long-lived, and incapable of sprouting. Therefore, where these species were dominant, we can conclude that fires were not as frequent or severe as in southeastern Massachusetts. Moreover, during the growing season broadleaf foliage normally holds enough water to be nonflammable. This moisture tends

to limit the fire season in our broadleaf forests to spring and fall, when the fallen dry leaves often burn in surface or brush fires. In fact, the combination of these factors led some to nickname the northern hardwood forest “the asbestos forest.”

Aboriginal Human Impact

American Indian populations migrated into Massachusetts shortly after the trees, some ten thousand years ago, but their populations remained quite low until four or five thousand years ago. Some researchers have speculated that the hemlock decline of about that time and the subsequent increase in species such as oak and hickory, which produce abundant large

nuts edible by both wildlife and humans, may have contributed to the increase in aboriginal populations.

Archaeological evidence indicates that human populations—like fires—were more numerous in the eastern than in the western part of the state during the period four hundred to a thousand years ago, with settlements also found along the major river basins.¹⁵ There is little evidence that these populations cleared extensive areas for agriculture. It is more likely that they created a patchwork of recently cleared areas, abandoned fields, and village sites in a matrix of intact forest. Population density (and presumably human impact on the forest) gradually decreased moving away from the coast,¹⁶ from a high of up to fifty people per square mile on Nantucket and Martha’s Vineyard, to four to ten per square mile in inland eastern and southeastern Massachusetts and the Connecticut River valley. It is unlikely that permanent settlements were made in the upland Berkshires.

Interestingly, the areas of high population density shown here match the distribution of the central hardwood and pitch pine-scrub oak forest zones seen on page 7. These are the forest types most suitable for burning. Although extensive debate continues regarding the frequency, extent, and broad-scale impacts of aboriginal burning, there is general agreement that these populations did burn forests to create fields and to rejuvenate understory browse for deer and other animals they hunted.^{16,17} No doubt this burning was largely restricted to dry areas where most vegetation was already adapted to fire, but it also intensified these conditions by reducing any fire-sensitive species that may have been present.



Areas of concentrated aboriginal human populations in southern New England during the Late Woodland period (1000 B.P.–400 B.P.) immediately preceding European settlement. Populations were concentrated along major river valleys, the coast and the larger islands of Nantucket and Martha’s Vineyard, and the lower reaches of broad upland areas.