New England's FOREST PRIMEVAL

by David R. Foster

What was the forest like originally?

Who among us, as we've hiked the Green or White Mountains, gazed from the traprock ridges across the Connecticut River Valley, or trudged across the sandplains of Cape Cod and the coastal islands, has not posed this question and used our imagination to remove the modern sights and sounds and allow the pre-European landscape to emerge? Certainly our predecessors did. From writers like James Fenimore Cooper to scholars like Timothy Dwight, a former Yale president who documented the early-nineteenth-century variation in New England's landscape, there has been a preoccupation with defining the region's primeval Nature. Perhaps Henry Thoreau framed the issue most succinctly when he wrote in the 1860s, "no one has yet described for me the difference between the wild forest which once occupied our oldest townships, and the tame one which I find there today. It is a difference that would be worth attending to."

Although nostalgia and a fascination with wilderness frequently motivate this quest, there are important practical considerations as well (Foster 1999). Ecologists have long recognized that landscape history affords remarkable insights into the variation in Nature, the range of responses of plants and animals to natural and human disturbance, and the ecological processes that have controlled landscape patterns through time. In similar fashion, conservationists have looked to the past—both to establish goals and to identify processes that are critical to the functioning of natural areas—as they have sought to restore species, communities, and landscapes (Foster et al. 1990, 1996). Thus ecologists, foresters, wildlife biologists, and conservationists have employed a wide array of tools and approaches to reconstruct historical and pre-European environments. These include explorers' and travelers' accounts, early surveys and maps, archaeological and tree-ring studies, and paleoecological analyses in which the vegetation, environment, and disturbance history can be inferred from the fossil remains of pollen, other plant material, and physical and chemical evidence like charcoal. Although there is an inclination to study old-growth forests as "remnants" of original vegetation (in New England especially), these stands are generally too small and unusual to provide much perspective into the broad landscape (Dunwiddie et al. 1996, Orwig et al. 2000).

With regard to regional patterns of variation at the time of European arrival, we have considerable insight and fairly broad consensus. It is when we turn to details within these patterns and their dependence upon human and natural disturbance processes that the records thin and the opportunities for speculation, disagreement, and future research emerge.

Four hundred years ago New England was predominantly forested, with the broad-scale variation in dominant tree species driven by climate and soils (Cogbill 2000). Although mean annual temperature and growing season generally decline to the north, the considerable variation in elevation provided by major north-south trending valleys and mountains, as well as the moderating influence of the ocean, produced a complex geographic pattern in vegetation. Patches of treeless tundra undoubtedly occurred on the highest mountains, but the northern and higher-elevation areas were dominated by spruce and balsam fir intermixed primarily with paper birch. Interestingly, although conifer species are associated with fire across much of the boreal region and the West, there is little evidence that fire was common or important in the moister New England conifer forests.

Broad areas of Maine, Vermont, New Hampshire, western Massachusetts, and northwestern Connecticut were covered with northern hardwoods—hemlock forest, dominated by long-lived shade-tolerant species such as beech, yellow birch, and sugar maple (C. Cogbill and Harvard Forest, unpubl. data). Paper birch was locally common along with white pine, pin cherry, white ash, and black cherry, especially on disturbed sites. To the south and at lower elevations the oaks increased, first red, then black, and lastly white. Geographic variation in species abundance and broad forest types were finely controlled by climate. In central Massachusetts, from the Connecticut Valley up across the Central Uplands and down onto the Eastern Lowlands towards Boston—a region incorporating only 200 meters in elevational relief and 1.5°C difference in mean annual temperature—the vegetation varied from oak-dominated to northern hardwoods-hemlock-white pine-oak and back to oak (Foster et al. 1998b). These forests of oak and hickory increased to the south across much of Connecticut, Rhode Island, and eastern Massachusetts.

One intriguing question about this pre-European landscape that generates considerable inquiry and speculation is: How much did vegetation patterns vary through time and across local landscapes? The evidence suggests that substantial change in broad-scale forest composition did occur in the centuries before European settlement. Most notably, 500–1000 years ago dominant species including beech and hemlock commenced to decline, and red spruce, and in some cases oak or birch, increased from Massachusetts to Maine (Fuller et al. 1998). The scale and timing of this change implicate the so-called Little Ice Age, a globally cool period of variable growing season. Since this period extended through the mid-nineteenth century, some

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of the vegetation changes that we attribute to settlement activity were undoubtedly initiated by shifts in global climate. Equally important, colonial settlement from Plymouth to Roanoke and Jamestown occurred under variable climatic conditions that posed severe challenges to successful crop production and human survival.

The Little Ice Age was not an isolated event. Pollen records indicate that vegetation and climate change have been continuous, though variable, over past millennia. For example, new records from the Quabbin Reservation in central Massachusetts depict a major shift from oak to chestnut composition and an increase in fire associated with drier conditions (lowered precipitation or warmer temperatures) approximately 1500 years ago (Foster et al. 2001). The long-term record completely dispels the myth of one "original" and stable vegetation, a single "primeval" forest. Instead we can appreciate the scene encountered in 1620 as part of an endlessly unfolding and dynamic picture.

Geographically, other factors, especially soils, modified broad forest patterns. Extensive coastal areas across southeastern New England, Cape Cod, and the coastal islands are largely formed of sandy outwash plains laid down by the glaciers. Here, and on more localized sandplains in the Connecticut and other valleys, oaks, pitch pine, white pine, and ericaceous plants such as huckleberry dominated (Motzkin et al. 1996, 1999a, Foster and Motzkin 1999). Meanwhile, the finer soils of the old glacial lake beds and extensive flood plains supported a mesic and specialized tree and herbaceous vegetation. Bedrock geology was also a key factor affecting vegetative distribution, as shown by the greater abundance of species like sugar maple on rich soils of the Berkshires, Green Mountains, and traprock ridges.

Natural disturbance also shaped the landscape. Early surveyors encountered windthrown forests, some of which were extensive and presumably generated by hurricanes or downbursts. Especially notable was the great hurricane of 1635, described by Governor William Bradford on the Massachusetts coast:

> *It began in the morning a little before day, and grew not by degrees but came with violence in the beginning, to the great amazement of many....It blew down many hundred thousands of trees, turning up the stronger by the roots and breaking the higher pine trees off in the middle. And the tall young oaks and the walnut trees of good bigness were wound like a withe, very strange and fearful to behold.*

Using similarly detailed eyewitness and newspaper accounts, meteorological descriptions, and a simple model of tropical storm meteorology, Harvard Forest ecologists have reconstructed the wind and damage patterns for all New England hurricanes since 1620 (Boose et al. 1993, 2001). The results show a strong gradient in hurricane frequency and intensity from southeastern New England to northern Vermont, New Hampshire, and Maine. Extreme storms, including hurricanes in 1635, 1788, 1815, and 1938, were experienced roughly every 85 years in the southeast, 150 years across western Connecticut to southeastern New Hampshire, and never (at least in recorded history) much farther to the north. Equally important was the incidence of weaker storms, which are critical to forest and wildlife dynamics because they create small openings (Foster and Boose 1994). These occurred every 5–10 years in the southeast, 10–25 years in central New England, and 75–200 years in the north.

Presumably, landscape-level patterns in forest structure would have resulted from the tendency for the strongest winds in New England hurricanes to come from the east and southeast (Foster et al. 1998a). On exposed level areas or east-facing slopes, intense winds would have initiated patches of younger, dense forest strewn with mounds resulting from the roots of downed trees and decaying wood (Foster 1988). In narrow valleys and on leeward westerly slopes, extremely long intervals without such damage would have led to predominantly old-growth conditions. The actual compositional effects of hurricanes on forests were probably minor. In fact, there is no signal for a pre-European hurricane in the pollen record of vegetation change.

In contrast, fires have left a definitive record in the form of charcoal and associated vegetation change in wetland and lake sediments. Using such records we can begin to develop a history of fire effects that greatly extends the limited ethnographic and historical references from the sixteenth and seventeenth centuries that have generated much speculation and disagreement. Fire in New England is generally interpreted as resulting from purposeful burning by Indians to improve hunting and village sites. Fire also is the major means by which a relatively small population of perhaps 90,000 individuals, lacking domesticated animals or widespread agricultural practices, could exert an extensive impact upon the landscape; fire and local human activity are primary means by which young and open vegetation and its associated early-successional plant and animal species may have been maintained in a largely forested landscape. Based on a handful of early quotes from Thomas Morton, William Wood, and others from a very few localities, extreme pictures of Indian activity and the resulting vegetation have been depicted: frequent to annual burning creating open, park-like forests, savannas of grass and interspersed trees, extensive sandplain grasslands, and mosaics of active agriculture and successional vegetation on fallow fields and abandoned villages (Cronon 1983).

Given the extent of old and multi-aged forest that would have predominated across most of New England four hundred years ago, many features that are now uncommon in our landscape would be widespread. Most obvious and abundant would have been the structural elements of old and deep woods—massive windthrow mounds and pits, large decaying boles of fallen trees, and dense jumbles of coarse woody debris in brooks, streams, and rivers.

The paleoecological record provides no support for these visions and when coupled with other historical data instead paints a very different picture of the broad landscape (Foster et al. 1998b, Patterson and Backman 1988). Sites from the central Massachusetts uplands do record fires and associated vegetation dynamics, but only at intervals of centuries to millennia. Although infrequent, fire did still modify this forested landscape, as sprouting and successional species such as birch, chestnut, and oak prevailed for more than 250 years after each fire (Foster and Zebryk 1993). In the Berkshires and the uplands of northern Vermont an even lower frequency of fire is recorded, presumably due to wetter conditions and lower Indian populations. Fire and human activity increased in the Connecticut Valley, to the south, and in coastal areas (Fuller et al. 1998). Higher fire frequency in these regions is associated with greater oak and pine, but even on the driest sandplains in the Connecticut Valley where fire may have been most frequent, forests of pitch pine and oak prevailed and, not infrequently, reached old-growth status (Motzkin et al. 1996). On the Cape and coastal islands, Native American populations and fire frequency were high and apparently created a mosaic of oak or pine forests with huckleberry, blueberry, and scrub oak understories. However, there is still no conclusive historical evidence for early-settlement scrub oak barrens, sandplain grasslands, heathlands, or savannas (Foster and Motzkin 1998, 1999). These hotspots of biodiversity, rarity, and modern conservation interest are

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much more likely the product of European land use (as they are, in fact, in Europe) than relicts of an aboriginal landscape.

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Thus, as we look backwards to the time before European arrival and the transformation of the New England landscape, we learn much about Nature. The forests were changing, though at a slower rate than today, and were varied, though less sharply and more along landscape lines than according to the arbitrary divisions of ownership and land use that drive many modern patterns (Motzkin et al. 1999b). The land was also occupied and influenced by people, wildlife, and natural processes that are mostly lost to us and about which we have much more to learn. But even though many changes in the environment, landscape, and biota are largely irreversible, the tremendous extent of forest as well as the diversity of cultural landscapes, ranging from fields to heathlands to sandplain grasslands, provide us with remarkable opportunities to preserve new wildlands and manage other reserves for biodiversity (McLachlan et al. 1999).

Nonetheless, in our efforts to interpret and conserve Nature, it is important that we take lessons from the past and use them to understand the present as we set off to shape the future. For, as Henry David Thoreau reflected in 1860, "if we attended more to the history of our [wood] lots we should manage them more wisely." ☾

David Foster *is director of the Harvard Forest (Harvard University, Petersham, MA 01366) and author of* Thoreau's Country: Journey Through a Transformed Landscape *and (with John O'Keefe)* New England Forests Through Time: Insights from the Harvard Forest Dioramas.

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