

FOREST SUCCESSION - THE HUMAN ELEMENT

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If we could trace all the details of plant succession it would be a way of capturing the subtle changes in our forests that would lend a very fine-grained historic perspective to our discussions here today. However as an economist, such a task is far beyond my poor ecological skills, so I'll confine myself to exploring the influences people have had on forest succession. This may be particularly important for those of us who live in the humanized landscapes that dominate New England.

When I got this assignment I turned to my dictionary to see what it said about succession. There I found it "may apply to things of any sort that follow in the order of time or place". Well, that certainly didn't constrain the scope of my paper, but it didn't give much guidance either. Then my eye caught another meaning, "Act of succeeding; sequence; as, a succession of disasters". Well, that suggested a place to start, if we really want to look at succession we must go back to the beginning of our present forest and the disaster that set the stage for it. The last glacier.

I always find it hard to imagine that a few thousand years ago there was about a mile of ice over this part of Maine. Even half a mile stretches me some, but no more than the idea that we are really in the third or fourth interglacial period and the ice will be back again to give us another fresh start. It's hard to remember that New England vegetation has been extirpated by ice several times in the past and that, in due course, it will happen again. For me that thought illuminates a new perspective on the word permanent.

Certainly when the ice decayed 10 or 12 thousand years ago, it started the largest scale primary succession on record. The glacial till and outwash soil contained no buried seed, no roots to sprout, no propagules of any kind, a classic case of primary succession, and certainly unaided by man. It wasn't very long before a tundra-like flora invaded to be followed by vegetation about like the boreal forest today. Wildlife must have developed right along with the plants because within 3,000 years Paleo-Indians appeared in New England to live off any available natural surplus. In this case succession had a major influence on humans and not the other way around.

Presumably, nature was pretty stingy under these harsh conditions because the human population stayed small. It's likely that these early folks had little impact on the land and that the forests went about their slow evolution largely unaffected. However, man also evolved and at least three more Indian cultures followed the first. The final civilization that contested with the colonists was heavily dependent on agriculture for staple foods and on the forest for meat, hides, sugar, fuel, bark and timber.

These folks have a reputation for being rather careless with fire and burned a good deal of the forest accidentally. They also are supposed to have set fires to improve travel conditions and hunting. However, this impact was probably confined to those parts of the region with the frequent summer droughts of a Mediterranean climate or extensive conifer stands which allow a fire to run easily. Although good burning days were rather scarce over much of the

region, the Indians probably did somewhat increase the natural frequency and extent of forest fires.

They also cleared land for farming, much of it on the river banks where annual flooding could rejuvenate the soil with silt. Because our glacial soils derived from granitic bedrocks have a low nutrient holding capacity, the Indians were probably as dependent on floods for a good crop as were the Egyptians along the Nile. Consequently, farming is likely to have affected a pretty small part of the region.

All together, it seems that man was a minor partner with nature in shaping New England forest succession throughout the Indian era. These folks were never very numerous, their stone-age culture supported small scale farming, which was important to them but was not extensive, their use of forest fire was constrained by a naturally humid climate, and they looked to the woods for a significant part of their livelihood. Once the ice disappeared it's likely that the major disturbing factors were not man but the periodic hurricanes and gales that uprooted and broke off trees in a wholesale manner. This natural upheaval no doubt also set the stage for some spectacular forest fires.

This balance between man and nature started to change rapidly when the Europeans arrived. Man's influence over forest succession increased by several orders of magnitude as the settlers took the landscape in hand and brought their iron-age technology to bear on the everyday business of making a living. For the colonists had the tools, the knowledge and the cultural drive to reproduce much of the civilization of the old world here in the new.

The Puritans, of course, had a special point to make -- that the social contract they had made with God would sustain them as an example to the world. They soon found that, as a way of life, hunting and trapping in the woods developed rough, independent characters who seldom came to church. This didn't fit the Puritan community and the forest, like the pool room in River City, became a socially undesirable place to hang out.

In addition, the population was exploding and the need for more food led to more farming and rapid land clearing so turning forest into farm land became the acceptable thing to do. The now familiar story of expanding agriculture radically changed the face of New England in a generation or two. Outside of the high mountains and Thoreau's North Woods, fully three quarters of the land was cleared. Forest area was so reduced that evapotranspiration fell and stream flow increased so that local watermills could run longer days, as some of the old residents remember. Colonial agriculture supported about fifty people to the square mile with many of the amenities of western civilization.

As we all know, however, the heyday of New England farming was brief and the decline was rapid enough so that trees reclaimed tremendous sweeps of the countryside during the latter half of the last century. Enough so that the old-field white pine which took over much of the area spawned a whole set of industries suited to its abundance in central New England. After extensive logging for timber and firewood to satisfy market needs, the next stage of natural succession was back to the mix of hardwoods and a few conifers that made up the precolonial forest. It was almost as though nothing had happened, in spite of all man's strenuous clearing, farming, and logging, the original tree species took over again at the first opportunity.

In the north country the sequence was different and the farming stage was skipped but firewood was early shipped south to Boston from the tidal rivers. Then logging started taking out the big pine and spruce. Lumbering worked up to such a fever pitch that Maine was the national center of the industry for a brief spell during the last century. The first time through the loggers concentrated on softwood saw logs, later as demand changed, pulpwood became important, and eventually the hardwoods were drawn upon for both log and paper. The forest has so far survived and prospered under this regime of heavy use and it's difficult to say whether human activity has radically changed forest succession. This is the question which is central to our thoughts today; has man upset the natural stream of forest development or has he merely created ripples on the surface of a deep running tide? I suspect that both are true, depending on your frame of reference!

Let's first take a very long view of forest succession and look through the eyes of our palynologist friends at the post-glacial pollen record of vegetation found in our bogs. Here the direction of change has clearly been from tundra, to boreal forest, to the pine maximum, and then about 2,500 years ago, to our present mix of species. On this evidence the forests we have now came into being and have remained essentially unchanged for two and a half millenia. Certainly long enough to call a climax forest!

Thus, when we look at the complex of tree species occupying the various parts of the region, they have been quite stable. In spite of the best efforts of man and nature, central hardwoods continue in the south, northern hardwoods and spruce fir are in the north, in between a transition zone and all laced with white pine and hemlock.

If stability characterizes the presence or absence of tree species throughout the region this does not mean that each acre has been unchanging. In fact, quite the opposite is true as we have seen with the old-field succession which has affected so much of the region. The clearing and abandonment favored some species out of the indigenous mix so the first step is cedar in the south, spruce fir in the north and white pine in between. Thus man changed the species that dominate the first stages of succession by creating the special environmental conditions that favor each one.

The same thing has occurred naturally and in a few places we have been able to study stand development over long periods of time. Evidence on the ground allowed Swan and Henry to reconstruct the development of a stand in southern New Hampshire undisturbed by man from the early 1600's to date. Their data show a largely hardwood stand blew down about 1620, this was followed some years later by a fierce fire which brought in a stand dominated by pine and hemlock in the 1630's; these trees developed with only minor recruitment of the odd hardwood until they all blew down in 1938. There was no fire this time and the new stand is mostly hardwood with an occasional pine and hemlock. Different species have dominated at different times, depending on events, but again the general mix has been quite stable over almost 400 years.

So what's the problem if all our evidence is that the forests of New England are quite tough and malleable, well able to roll with a punch and recover quickly? Even if the natural world is full of forces which defoliate, rot, debilitate, burn or uproot trees, they seem so well adjusted to this battering that human assaults haven't made much difference. Perhaps this has been so in the past, but what about the future? Has man so radically changed

the forest environment or disturbed the system in such new ways that future development is becoming largely unpredictable?

Let's look at how various forces are likely to work out. In the past the truly extensive human change was clearing forest for farming but this has largely stopped. So, too, has abandonment as agriculture seems to be stabilizing in the last few years. Although this kind of disturbance was uniquely human and didn't mimic any natural change, the forests took it in stride and it's not likely to be of signal importance in the future.

In the years ahead land use change is more likely to involve construction for infrastructure and housing and this is more destructive of soils and, perhaps, more permanent than farming. Fortunately, a large expansion is not likely and all urbanization taken together still occupies only a small percentage of the region. Even though such change may be as radical as that of a glacier, it's more selective and not so universal.

One by-product of urbanization, however, may be climatic changes which aren't so easy to shrug off. At the moment there is nothing definitive about the impact on temperature, the greenhouse warming effect of CO₂ may offset by the cooling of increased dust -- or more likely, our instrumentation is not up to the task of identifying and measuring significant change. Similarly, we aren't sure about increases in dry and wet acid precipitation and the effects likely to follow. All told, climatic effects are worrisome but unclear and must be studied closely so that we don't stumble unwittingly into some deleterious and hard-to-reverse change.

Among the more spectacular events, man has probably reduced fire incidence and extent rather than increased it. But, in any case, fire has never had as large a role in shaping the forests of New England as it has in many other parts of the country. It rains too often in the northeast to foster the fire patterns we find in the west and in parts of the south.

Hurricanes and storms continue to blow down trees in New England before many of them can reach any great age. With three widespread and devastating hurricanes in the last 300 years, it's not surprising that a tree over a couple of hundred years old is a phenomenon. It's no accident that of the 31 species mentioned by Henry Clepper in an article in *American Forests* as having specimens known to be over 400 years old, only two are found in the east. Our wind storms are too frequent and too fierce.

This leaves logging as the human activity likely to affect a significantly large area in the future, especially in the north. Certainly the age distribution of trees is affected so we probably have a more balanced distribution of ages from continuous logging than would result from periodic natural catastrophies. We may also lose less to violent winds because we carry fewer large susceptible trees. Because logging creates a more or less steady stream of various sized openings, it is likely that we have more stands dominated by the fast-growing intolerant species that pioneer these gaps than we would have from episodic natural disasters. However, most logging and most catastrophies create even-aged stands so this important forest characteristic is probably little affected by man.

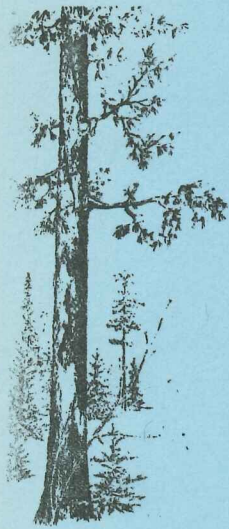
There is no doubt that merely cutting a tree has no impact on soil erosion. However, the equipment used to skid and truck that tree can certainly compact soils and cause considerable erosion. Good engineering and careful equipment operators can largely control erosion but some increase is inevitable as logging progresses.

There is a good deal of concern that removing products from the woods will carry away much needed plant nutrients. Some certainly are lost in products or to accelerated decomposition and leaching. It is likely that under past practices the loss has been negligible and replaced reasonably promptly. As we edge toward whole-tree harvesting, especially in a way that carries off the nutrient-rich twigs and foliage, the loss might become significant on some marginal soils. This is something we will have to watch and study, but so far impacts have been undetectable.

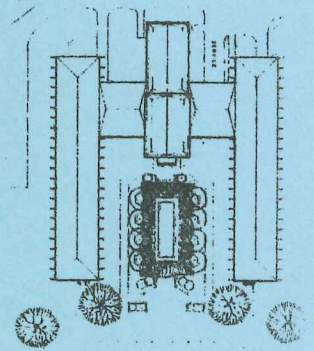
Another imponderable impact of logging on the forest is the genetic result of a sort of reverse selection that comes from the extensive high-grading practiced over the centuries. We have generally cut the biggest and best-formed trees and left behind the poorer ones to produce seed. Reproducing from culls that may be that way because of poor genes could cause a significant decline if done long enough. I don't believe anyone has a reliable measure of actual decline, or is sure that one has really occurred. The possibility, however, is worth thinking about by those in a position to design harvest systems that can foster positive selection of seed from superior sources.

What is the likely net effect of logging on forests and succession? Certainly we have a more varied forest in size and age. The even-aged form is probably little changed, however, and one likely sees more intolerants than otherwise. But it seems certain that these are merely details, important as they may be, and that the extent of the forest and the tree species that inhabit the region are essentially unchanged.

What does all this suggest about an appropriate role for humans to play in forest development in the future? The probability is that the forest won't change its basic nature much in spite of us. But human satisfaction from the forest is greatly affected by precisely those details about forest structure that we can control. Age and size, the quality of stems, the control of erosion and runoff, the enrichment of habitats by varied species, size, stand density and openness. All these are largely under the control of forest owners and their adroitness in using these variable to design their woodland environments can bring great satisfaction to them and the public at large. In a very real sense the landowner is the pivotal natural resource.



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