THE ROLE OF FIRE IN THE MANAGEMENT OF THE PINE BARRENS: SUFFOLK COUNTY, N.Y.

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ABSTRACT

Frequently the techniques used in the management of woodlands are based on an inadequate knowledge of the history and pre-history of a given area. Often the assumption is made that the present day forest composition reflects that of the woodland prior to European contact. As a result, the management strategies employed may, in fact, perpetuate decades, if not centuries of mismanagement.

This is particularly true on Long Island where woodlands, dominated by the fire dependent pitch pine *(Pinus rigida)*, are assumed to reflect the species composition of the pre-European forests. As a result, fire is considered to be necessary for the maintenance of these woodlands.

Pollen analysis, early historical records and comparisons of burned vs. unburned plots indicate that fire may be a post-European influence in the Long Island forests. Moreover, the analysis of maps and historical aerial photographs indicate that the clear-cutting and/or clearing of earlier hardwood forests may have enabled the shade intolerant pine to enter and dominate the Long Island forests within the past 400 years. Thus, the pine barrens of Long Island may actually be a post-European artifact brought about and maintained by the mismanagement of the hardwood forests.

INTRODUCTION

The role of fire in the management and maintenance of the woodlands of Long

Island is questionable. Although the pine barrens, which comprise a 52,000 acre New York State Preservation Area, are purported to be a fire dependent ecosystem, it is probable that the pre-contact woodlands were dominated by hardwoods and that the pines are the result of mismanagement during the Colonial and post-Colonial periods. Conversely, studies by Conard (1935) and, more recently, by Boerner, et. al. (1987) indicate that fire may actually hasten the succession to oak *(Quercus sp.)*.

That the pre-contact woodlands may have been dominated by hardwoods is based on the time that Long Island has been icefree, thereby allowing biological succession to proceed, as well as early historical records and various pollen studies. In addition, surveys of cleared areas show that pines rapidly colonize these mineralized sediments. Moreover, studies of recently burned areas confirm those of Conard (1935) and Boerner, et al (1987).

Long Island was formed by sediments deposited during the last advance of the Wisconsinian Glacier which retreated some 20,000 YBP. Immediately following the retreat of the glacier the climate was considerably colder and moister than at present. Such a climatic regime would have resulted in vegetational communities akin to the arctic tundra. As the glacier continued its retreat the climate moderated and forests similar to the spruce-fir communities of present-day Newfoundland would have predominated. Somewhat later, again in response to further climatic moderation, a northern transitional hardwood forest such as that of New England would have dominated the landscape.

Approximately 8,000 YBP, during the Hypsithermal, the climate became considerably warmer and drier enabling more southerly species to establish. This could have led to the decline of the northern hardwood transitional forest. It is probable that the pitch pine *(Pinus rigida)* became established during this time. The climate then moderated, and for the past 4,000 years the temperature and precipitation patterns have been fairly constant and similar to those of today.

During this time a complex soil structure was developing. As noted, pines are presumed to have colonized the area during the Hypsithermal. The slower growing oaks (Quercus spp.), hickories (*Carya* spp.), red maple (*Acer rubrum)*

and the chestnut *(Castanea dentata)* were present in lower numbers.

Over time, and in the absence of frequent disturbance that would open the canopy, the hardwoods would tend to eliminate the shade intolerant pines. Thus, the species composition would have shifted to one in which the hardwoods predominated. The pines would persist and be confined to areas subject to a higher frequency of disturbance which would adversely affect the hardwoods and favor the shade intolerant species.

Such vegetational sequences since the end of the Pleistocene appear to be confirmed by palynological studies. Sirkin (1989) has found pine pollen at higher percentages than oak in sediments dating from approximately 10,000 to 5,000 YBP, while those f rom 5, 000 YBP to the present show the oak pollen to be at a significantly higher percentage than that of the pine.

Two thousand years would be a sufficient time to develop an old growth stage of hardwoods provided that severe, extensive and rather continual disturbance did not bring a return to an earlier vegetational stage.

Thus, extensive pine forests could only have persisted by frequent disturbance and, on Long Island, the only natural disturbance would be fire. The only natural cause of fire, however, is by lightning strikes. Lightning, on Long Island, is generally preceded by heavy rainfall. It is generally agreed that fires set by lightning in a wet woodland are rare (Patterson, 1988). If the pre-European forests were, in fact subject to frequent disturbance, either by clearing or fire, the cause would be anthropogenic rather than natural.

There is considerable controversy as to the extent of burning by pre-contact Native Americans (Russell,1983; Patterson, 1988). At the time of European contact the Native Americans inhabiting Long Island had developed a lifestyle based on shell and fin fishing as well as on agriculture. Patterson (1988) notes that burning was proportional to the population density, while Ceci (1977) estimates that the Native American population at that time was less than 4,000. This is a population density of less than three individuals per square mile and argues for a minimum of human disturbance, both before and at the time of

European contact.

Based on the pollen record for Long Island, the presumed succession during the Holocene and the low population density of the Native Americans at the time of European contact, as well as the low, pre-contact fire frequency, it is logical to assume that the forests of Long Island in the early 1600s were dominated by oak, hickory and chestnut. Pines were confined to those areas experiencing frequent disturbance. Thus, the role of the early settlers needs to be considered since it is probable that their activities had a profound effect on the species composition of the Long Island forests.

It is known that the early settlers considered the forest as a vast and exploitable resource. The land was cleared for farming and wood was cut for home construction and for cordwood, the only source of home heating fuel. Somewhat later, wood was cut to supply Long Island's shipbuilding industry.

Pitch pine is generally not preferred for home or ship building. It is also considered to be a dangerous heating fuel since its resins coat chimneys and cause house fires. However, the Long Island forests were the major source of wood for New York City's heating needs. By 1812, Brookhaven Town, located in central Long Island and the area presently containing the majority of the pine forests, was sending 100,000 cords of wood per year to the city (Prime, 1845). Wood cutting on this scale, combined with that cut for local needs would have virtually eliminated the hardwood forests and allowed for the reestablishment of the shade-intolerant pines in the absence of fire.

The presence of an earlier hardwood forest is confirmed by the records of Camp Upton, now the site of Brookhaven National Laboratory. Although the surrounding forest is now dominated by pine, it was necessary when clearing the area in 1917 to remove closely spaced hardwood stumps that were commonly six feet in diameter (Coyne, 1919).

Fire did become a major factor in the Long Island woodlands in 1844 when the New York to Boston link of the Long Island Railroad, which traversed the present central pine barrens, was completed. Sparks emitted from the coal

burning locomotives caused widespread, well documented forest fires. One fire burned an area 10 miles long and four miles wide. Historians noted that portions of the forest were burned almost daily by the rail road (Treadwell, 1912). Fires of this magnitude were obviously sufficient to perpetuate a fire dependent woodland.

STUDY SITES

The major areas considered in this study are the 5,247 acre Rocky Point Natural Resources Area and the 1,775 acre Dwarf Pine Plain. The Rocky Point Natural Resources Area was previously owned by the Radio Corporation of America and was the site of a trans-Atlantic transmitting station from 1921 to the 1960s. Much of the area was cleared for antennas and fire was suppressed. The Dwarf Pine Plains are purported to require the highest fire frequency in order to maintain the stunted, contorted growth form. Both of these sites are located in the 52,000 acre New York State Pine Barrens Preservation Area. In addition, several smaller sites outside of the preservation area were considered in order to assess the effects of fire and/or clearing (Figure 1).

MATERIALS AND METHODS

A number of methods were used in this study. Quantitative studies involving the establishment of 400 square meter circular plots in which the heights of all of the pines were measured and the degree of tree bole distortion determined and categorized as straight, moderately or extremely contorted. In addition, representative trees in each plot were cored in order to determine their age. Semi-quantitative methods involved line transacts and the point quarter technique, as well as Rapid Environmental Assessments as devised by Welch (1994).

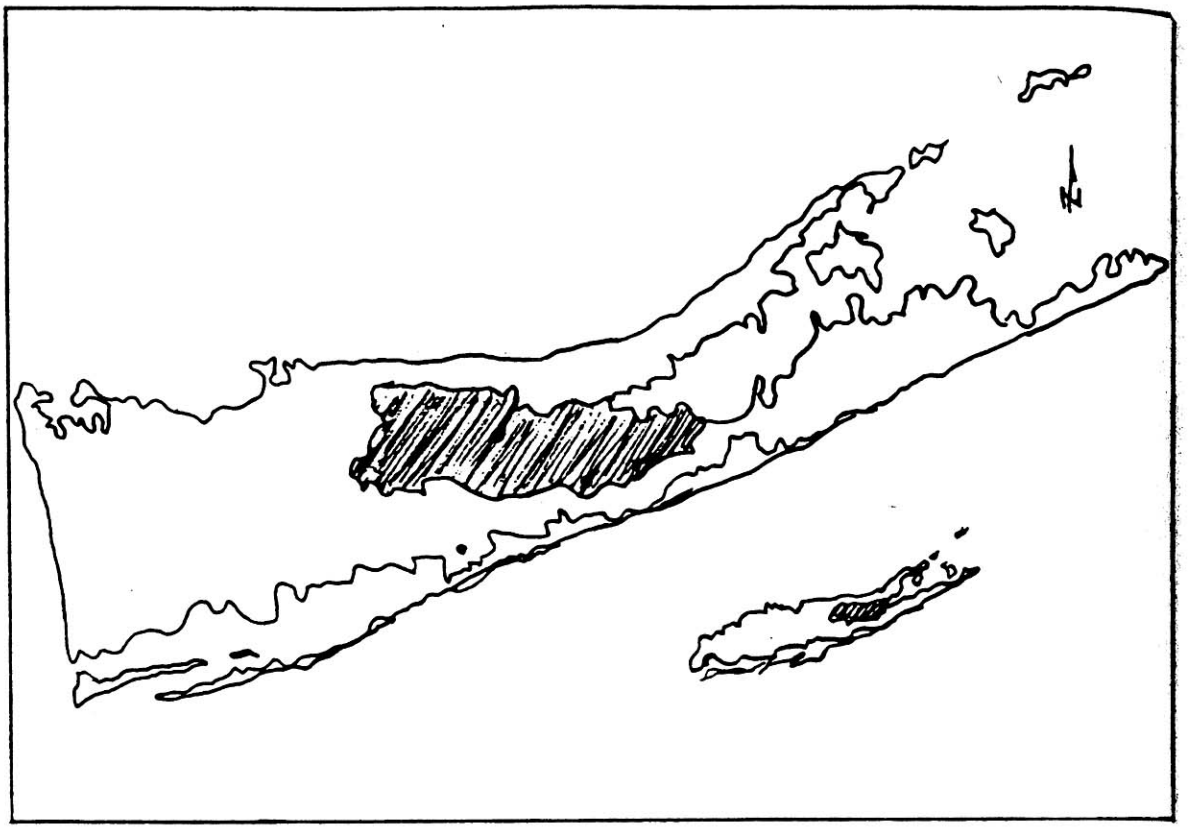

Figure 1: Shaded area indicates the central pine barrens of Suffolk County. Dots indicate study sites.

According to this method soils and topographic data are determined prior to the site visit. On site, the area is traversed in several directions and the herb, shrub and canopy layers are described, as well as the general structure of the community, approximate vegetational density, percent cover and dominance of the various floral components.

In addition, various sets of aerial photographs, dating from 1932 to 1990 were used in order to determine the time frame in which certain areas had burned, were cleared, etc.

RESULTS

General observations, semiquantitative and quantitative studies consistently indicate that pitch pines tend to dominate recently cleared areas such as fire breaks, old fields, etc. For example, in virtually all of the fire breaks surveyed, pitch pine was the first to invade and appears to maintain its dominance for decades. Indeed, in many fire breaks it is the only tree present regardless of the time elapsed since the last clearing.

In addition, the analysis of the forest types on the 5,247 acre Rocky Point Natural Resources Management Area indicates that pitch pine dominates those areas that were cleared frequently between the early 1920s and 1960s. The adjacent areas, on the other hand, have been subject to little, if any clearing and are dominated by scarlet oak *(Q. coccinea)* with black *(Q. velutina)*, and white oak (Q. alba) present in lower numbers. This indicates that the pitch pine invades and dominates on cleared, highly mineralized substrate in the absence of fire.

Fire, including prescribed burning, may, in fact have a deleterious effect on pine communities. Conard (1935) notes that fire eliminates the pitch pine while favoring the growth of scrub oak in the Long Island pine barrens. Boerner, et al (1987) in a study of the New Jersey Pine Barrens notes that "prescribed burning may accelerate, not retard, succession toward oak dominance".

This appears to be confirmed by semiquantitative surveys carried out on several areas on Long Island. This data clearly shows that, in pine barrens that have burned approximately 15 to 20 years ago, there is now a predominance of oak. Moreover, in the majority of these areas there is a total absence of pine recruitment.

In addition, sample plots in the dwarf pine forest, purported to require fire on the order of every seven years (Olsvig, et al, 1979) show just the opposite. Plots established in an area documented to have burned in 1945 show a lower density of pines than a control plot with no documented burn history. Moreover, the number of individuals exhibiting the growth form indicative of the dwarf pine

phenotype is significantly higher than in the control plot.

Very early data obtained in the wake of the wildfires of August 1995 indicate that in the Dwarf Pine Plains the scrub oak *(Quercus ilicifolia)* is rapidly resprouting in the burned area. Within four weeks of the fire the oaks had numerous root sprouts which had attained a height of 0.5-1 meter. Within four months only approximately 50% of the pines had begun to resprout; however, by late April, 1996 many of the pine root sprouts had "browned" and may have died over the winter. The oaks, on the other hand, were robust and continued to dominate the area.

By early summer in the Rocky Point Natural Resources Area, however, epicormic sprouting was common on the pines and a number of new pine seedlings were also noted. Again, however, oak was dominant.

SUMMARY

The forests of Long Island were most probably composed of an oak-hickory-chestnut assemblage at the time of European contact. Over-cutting of this hardwood forest by the early settlers eliminated the hardwoods and enabled the reestablishment of the shade intolerant pitch pine. Although the early railroad is known to have caused extensive wildfires, the impact of such fires is unclear.

Semiquantitative surveys of several areas known to have experienced recent wildfires seem to confirm Conard's (1935) data. Moreover, qualitative surveys indicate that pines rapidly invade and prosper on cleared areas in which the subsoils are exposed. Such areas include fire breaks, antenna fields, etc. The dwarf pines are purported to require the most frequent fire regimes in order to maintain the "dwarf" growth form. Quantative studies, however, indicate that the dwarf phenotype is much more common in areas with no fire history. It is believed that competition with scrub oak, which dominates these areas, rather than fire, forces the pines into the contorted growth form. Moreover, these studies also show that there is a higher population density of pine in the unburned areas.

The value of prescribed burning in the management of the pine barrens remains in doubt. As noted Boerner (1987) holds that prescribed burns may accelerate succession toward oak. Baker (1995) also believes that small prescribed burns will further alter the forest, while larger fires may hasten the restoration of the landscape. It appears obvious that prescribed burning as a management strategy in the Long Island pine barrens is questionable.

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