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TWENTY-FIVE YEARS OF VEGETATION DEVELOPMENT SINCE THE BAXTER FIRE OF 1977

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1. ABSTRACT

Fire is widely recognized as an important natural disturbance agent impacting ecosystems throughout the world. Post-fire vegetation dynamics and subsequent management implications substantially differ in each region. Because north central Maine is believed to have a long return interval fire regime (at least 800 years according to Lorimer (1977)), the threat of catastrophic fire in one's lifetime seems remote. However, with an apposite synergy of events, historical evidence supports that severe fires can and do occur in the Acadian forests of Maine. Knowledge of vegetation re-growth following these burns will improve predictions for forest dynamics in Acadian spruce-fir ecosystems. Evaluating the implications of interacting disturbances (pre-fire wind event, harvest, burn) on post-fire regeneration could facilitate future management decisions. Vegetation development following a fire plays a key role in providing critical information to help refine historical fire regime calculations. Currently, no conceptual model of post-fire development exists for this region and research has been limited.

A series of interacting disturbance events occurred in Baxter State Park in Maine offering an excellent opportunity to study long-term changes in vegetation. In July of 1977, 1439 hectares in and adjacent to Baxter State Park experienced a severe forest fire. Much of the fire burned areas that were blown down in a 1974 windstorm; some of those areas were salvaged prior to the fire, while others were not. In 1978, Sandra Hansen set up plots to represent the various stand conditions and measured vegetation composition and structures a year following the fire.

The current study will re-establish these plots and document current vegetation structure to improve our understanding of forest development. Specific research objectives are to: 1) relocate the original plot markers, 2) describe post-fire vegetation development in an Acadian forest stand, and 3) evaluate the influence of pre-fire disturbances on the post-fire regeneration process.

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2. INTRODUCTION

Previously viewed as an interruption to nature, fire has been recently credited with playing a key role in natural processes (Barnes et al. 1998). The effects of fire on development patterns in forest stands are an important component of these ecological processes. While wildland fire ecology is studied throughout many parts North America, it is relatively little studied in the northeastern United States and especially in the Acadian spruce-fir ecosystem where there is a relatively cool, humid climate and seemingly lengthy fire return intervals. Because north central Maine is believed to have a long fire return interval, the natural role of fire has been downplayed in this region. Lorimer (1977) postulated a fire regime of at least 800 years for north central Maine.

Personal communications with many scientists and natural resource mangers suggest that charcoal, a clear indication of fire history, can be found virtually on any spot of land throughout the north central part of the state. Fires continue to occur in Maine; however, during the last fifty years most of the fire starts have been successfully and rapidly suppressed. If they were not suppressed, they would have had a greater impact on the forests in the region. Maine has vast forest resources that provide an important economic base for the state. Many land owners and managers already recognize fire as a threat (on the scale of a lifetime, not 800 years) (Crammond 2002). All it takes is the right combination of weather, fuel, and ignition. In addition, disturbances can interact to create the right conditions for large impacts. The Baxter Park Fire was a classic example of interacting disturbance events. In this case, it involved a windstorm, some salvage of the blowdown, and then a wildfire.

In November of 1974, the synergy of events began with a severe windstorm affecting 2000 hectares in and around Baxter State Park (Scee 1999). The wind damage resulted in a considerable fuel accumulation on and above the forest floor. The Baxter Park Authority recognized the potential fire danger and proposed a salvage operation to clean up the blowdown. This proposal received a large amount of opposition. The late Governor Percival Baxter gave the lands in Baxter State Park to the people of Maine under certain deeds of trust. Because of this, there are many rules and restrictions associated with the management of the park. Harvesting of any kind is one of these points of contention. The outcome resulted in wind throw salvage only in areas of the park where Great Northern Paper Company still owned logging rights. Meanwhile, blown down sections in the park under stricter management were left unsalvaged due to extensive litigation (Scee 1999). In the midst of the court battle, on July 17, 1977, two lightning strikes ignited forest fires on Baxter State Park lands in blowdown area caused by the earlier windstorm. Weather conditions were ripe for fire. High winds and limited access made immediate suppression difficult. Over 1400 hectares burned over the next few days both in parklands and on adjoining Great Northern Paper Company lands (Bowen 1978).

Hansen set up plots a year after the fire that represented various disturbance history categories (Figure 1). Two types of pre-disturbance conifer dominated stands were evaluated. These were densely stocked stands ranging from 0 to 9 meters in height and moderately stocked stands greater than 9 meters in height. Windthrown and subsequent salvage stands are limited to moderately stocked stands greater than 9 meters in height. The plots included stands that fall into one of six disturbance history categories. These categories are: 1) burned; 2) windthrown/burned; 3) windthrown/salvaged/burned; 4) unburned; 5) windthrown/unburned; and 6) windthrown/salvaged/ unburned. The two pre-disturbance stand types and each disturbance history category are represented by one stand if unburned and two stands if burned. Five plots were randomly located in the twelve stands representing the range of stand conditions and disturbance histories. In total, 60 plots were established.

Hansen placed rebar stakes as plot markers and measured vegetation and soil on each of these plots during the summer of 1978. She found that organic matter depth decreased with an increase in disturbance and burned plots had a higher pH in the soil. Results show 24 plant species in the unburned plots were not found in the burned area; notably these included some conifer species and several bryophytes. Eight new species appeared in the burned areas that were not present in the areas unaffected by the fire.

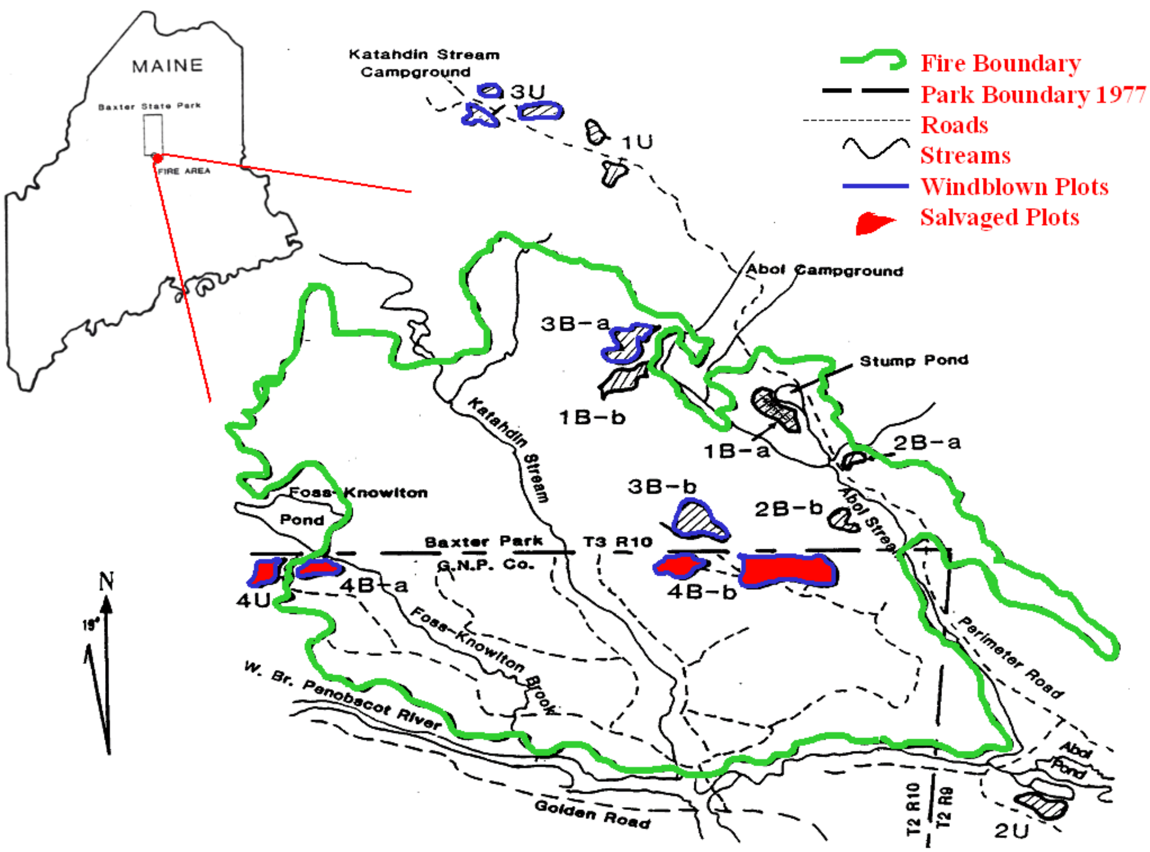


Figure 1. Fire Area Map (modified from Hansen 1983).

The most remarkable of these were fungi (Hansen 1983). Bristly sarsaparilla, A*ralia hispida*, was remarkably common among the burned plots, forming a "sea" of vegetation the first few years following the fire (Kimball 1982).

The main objectives of this study are to relocate these permanent plots to track and describe vegetation composition and structure changes since 1978 and to evaluate the influence of the pre-fire stand conditions on the regeneration by comparing the plots within the fire (burned wind thrown areas, those still standing when the fire occurred, and those that were salvaged).

3. PLOT RELOCATION

During the fall of 2002 and the spring of 2003, we searched and located 54 out of the 60 rebar stakes. Due to inaccuracies and imprecision built into hand drawn maps, we devised a method to provide coordinate search points prior to field exploration. Ortho photos of the area were used to locate origins and landmarks. Using recorded azimuths, pacing distances, and clues alluded to in the site descriptions, expected locations of the plots were identified using MapInfo, a GIS program. The coordinates of these positions were downloaded into a Garmin Global Positioning System III Plus for field search. The GPS would direct searchers to expected locations of plots. A diameter spiral search pattern from the expected location combined with plot descriptions, photographs from 1978, and luck helped to locate 90% of the plots after 25 years. Figure 2 compares recorded coordinates for five plots to plot locations estimated from the original maps.

If the stake had fallen over or was obscured by a fallen tree, a metal detector was used to locate it. Once the stake had been located, several positions were documented using the Garmin III Plus GPS and a Trimble Geoexplorer III. Once some plots from a stand had been located, missing plot positions could be reassessed by mapping the actual stake locations and adjusting the expected location.

A yellow cap was placed on the top of each stake for purposes of increased visibility, safety, and to provide clarity to both future researchers and the public. Each cap denotes plot numbers within the stand by the

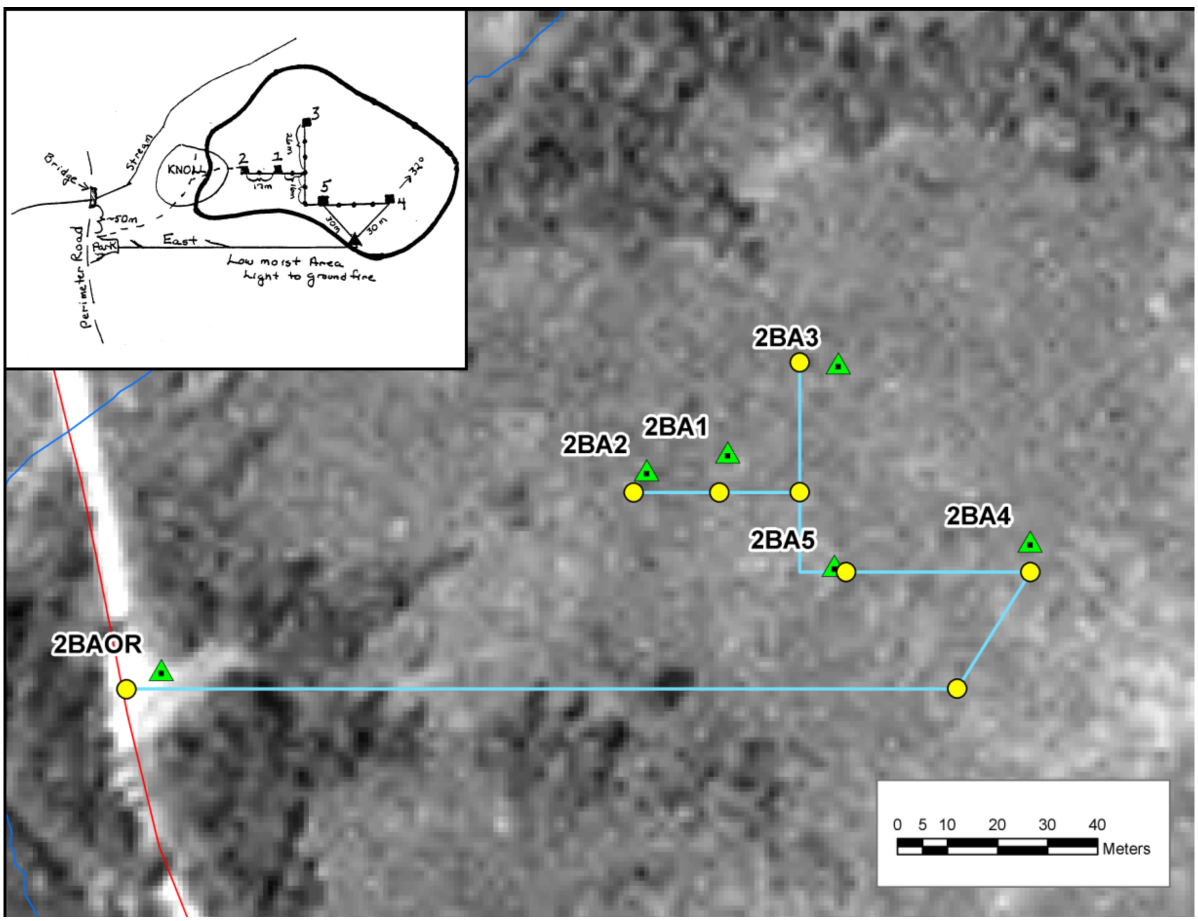


Figure 2: Hansen's map (upper left) was used in conjunction with ortho photo quads to determine spatial coordinate locations of each plot (yellow dots). Field searches found the actual plots marked here as green triangles.

number of holes inscribed in the cap. For the six cases of missing plots, new plots were established at the coordinates identified for the plot based on the original maps and plots located in the same stand.

By establishing the spatial coordinates for these plot markers, future measurements for a continuation of this study can be facilitated. The position of each stake will be located on a map as well as outlined on aerial photographs of the fire area. Suggestions for future relocations include downloading the coordinates and using aerial photographs and maps to locate major landmarks such as roads and access points.

4. METHODS

Once each plot was located and laid out using the rebar stake as the southwest corner of a 10 by 10 meter square, vegetation was tallied during the months of July and August 2003 (the same time of year as in 1978).

In the main plots, each tree was identified to species and measured at breast height (1.3 meters) using either an aluminum tree caliper or a standard diameter tape. Trees below breast height were tallied without a diameter. Height and live crown ratio was measured for four trees on each side of the plot in each canopy position category using a Suunto clinometer at a distance varying from 5-15 meters. Subsequent heights were estimated to the nearest meter using the measured trees as a visual guide. Each tree was assigned a canopy position (Dominant, Co dominant, Intermediate, and Overtopped) based on position among surrounding trees in the stand.

Subplots, one meter by two meters, are nested in each of the four corners of the main plot for the purpose of examining forest floor components, herbaceous plants, and woody shrubs. Forest floor cover in percentages of organic matter, soil, wood, and roots was recorded for each subplot; and herbaceous plants, bryophytes, lichens species, and woody shrubs not classified in the main plots were identified with percent cover determined for each species. In addition, a species list was compiled for all species found in the main plot.

Dead and downed material was examined in three plot sizes depending on diameter. All coarse woody debris (CWD) with a large end diameter greater than three centimeters (cm) was recorded in the subplots. CWD greater than seven cm was tallied in a newly created plot forming a five meter by five meter square in the southwest corner of the plot. All logs greater than 15 cm were recorded in the original main plots. Only the portion of each log that was actually in the plot was measured. Small and large end diameters and length were recorded, as well as decay class (1-4) assigned.

Two locations per plot served as sites for determining organic matter depth—two meters south and two meters west of the rebar stake. The technique for measuring the depth of the organic matter (OM) was simplified to a basic field measurement. A hole 15 cm on each side was created at each site using a knife and a template. OM depth was measured on each of the four sides of the hole.

5. RESULTS

Six disturbance history conditions are used as factors in the analyses (Figure 3). Preliminary results show that stands wind thrown and left unburned had the highest number of trees per hectare. The greatest average diameter at breast height was found to be in the stands that were not wind blown or burned. Unburned stands had a greater percentage of conifers compared to hardwoods than stands that were burned. To make comparisons among factors, multivariate statistical analyses will be accomplished using a variety of methods including: Detrended Correspondence Analysis, Cluster Analysis, or multiple regression techniques. Analyses will concentrate on identifying development patterns in the last 25 years (Figure 4) and similarities and differences among disturbance history factors.

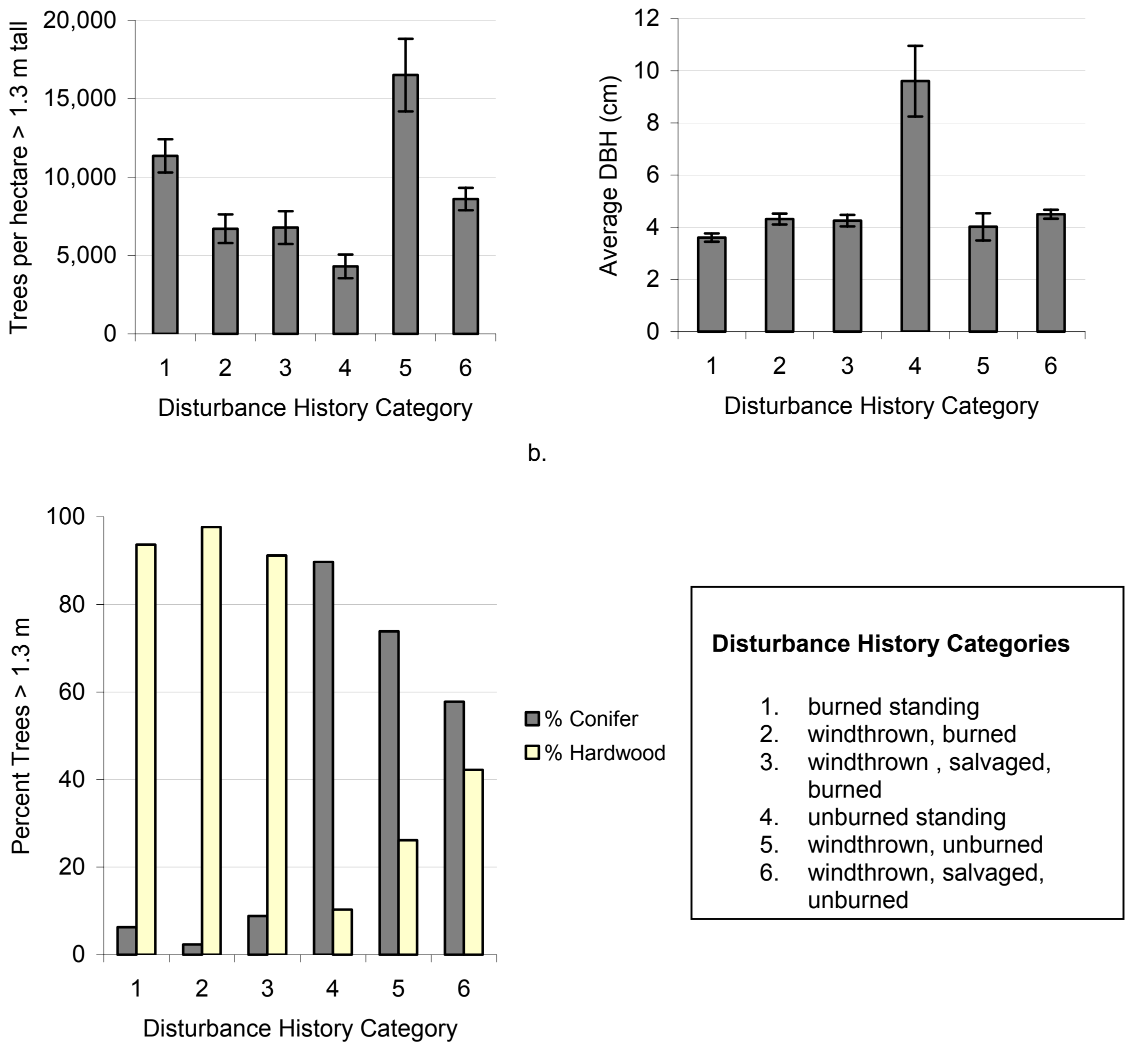
6. DISCUSSION

Data collected in this study describe the current species composition and structure in each of the stand conditions. Differences between the stands are expected, especially between those that were standing or salvaged prior to the fire, as opposed to stands that were blown down in1974. Differences in data collected in 1978 compared to 2003 may be significant. Conifer species may have increased at different rates depending on stand condition since 1978.

The Baxter Park Fire of 1977 is an example of a natural fire where the fire's behavior and impacts were modified by a previous disturbance event and human manipulation. The long-term impacts of such fires are important to consider. Sandra Hansen stated the purpose of this study was to "collect baseline data for long-term studies to see vegetation development after a fire and over time" (Hansen 1983).

Wind and fire events will occur again in Maine, and are likely to follow a similar sequence. The effects of these disturbances have been given relatively little attention historically. While the rest of the country has become focused on fire policy and management dilemmas, Maine and the Acadian spruce-fir ecosystem remain in a zone where fire effects are poorly documented.

This research will expand our knowledge about blowdown salvage, fire management, and fire ecology. It may help the park, the state, and other land owners to design future fire policy and make more informed decisions regarding fire suppression. Baxter State Park currently has a full fire exclusion policy; they plan to suppress each fire with any measures necessary. They would like more information on the effects of the fires, the effects of suppression, and forest development that occurs following a burn.



a.

b.

c.

Figure 3. Preliminary Results. a) Tree per Hectare in Disturbance History Categories, b) Average DBH, c) Percentage of Conifers and Hardwoods

(a) Plot 2b-a1: 1978

(b) Plot 2b-a1: 2003

(c) Plot 2b-a2: 1978

(d) Plot 2B-a2: 2003

Figure 4. Photographs over time of plots in Stand 2b-a (burned standing) also show rebar stake plot markers

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