Southern New England Old Growth Forests: How much is left and can they help inform management decisions? - *David A. Orwig and Anthony W. D'Amato, Harvard University*

The remaining resource

Old-growth forests are widely recognized as valuable resources for investigating natural forest ecosystem structure, dynamics, and properties and serve as critical benchmarks for comparisons with forests influenced by human land-use. Despite their importance, these ecosystems have not been extensively studied in southern New England due in large part to their scarcity on the landscape. It is estimated that < 0.1 percent of the total forest area in Massachusetts is currently represented by old-growth forests (~ 450 ha). Recently completed studies investigated the disturbance dynamics and structural and compositional attributes of the 18 largest remaining old-growth properties in western Massachusetts. The vast majority of remaining old-growth forests are small in size (< 10 ha) and located on rugged, steep terrain (20 to 46^{o} slope) within the Berkshire Hills and Taconic Mountains of western Massachusetts (Figure 1). Poor site characteristics and an unfavorable agricultural climate presumably protected these areas from extensive land use.

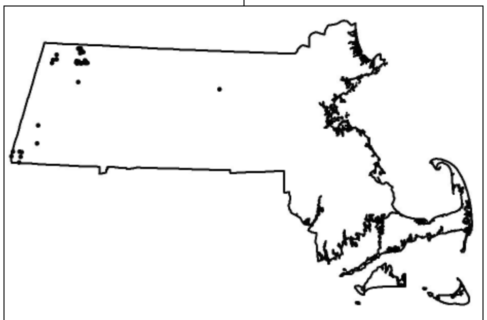

Figure 1. Location of old-growth forests on public land in Massachusetts. Research discussed in this report focused on the sites in the western portion of the state.

Composition, Age and Historical development

Compositionally, stands consisted of 50 to 92% hemlock basal area and minor components of red spruce (*Picea rubens*), birch (*Betula*) and maple (*Acer*) species. Two stands were composed primarily of sugar maple (*Acer saccharum*), beech (*Fagus grandifolia*), birch and white ash (*Fraxinus americana*). By examining tree-ring patterns of all stems within several permanent plots per site (50 to 150 stems/site), we were able to examine the age structure and reconstruct past disturbance dynamics in these forests. Average stand age of overstory stems ranged from 180 to 246 years while the maximum age obtained in each stand ranged from 277 to >450 years old. Several tree species reached their known upper limits such as 414 years for red spruce, 488 years for eastern hemlock and 332 years for black birch.

Reconstructions of past stand history highlighted that forests commonly experienced relatively frequent, low intensity disturbances, with an average yearly disturbance rate across sites of 0.5% of the canopy area. There were no stand-replacing disturbances detected at any old-growth area. However, when dendroecological patterns were compared with model simulations of past hurricane events and historical documents, broad-scale disturbances such as hurricanes and ice storms did impact forests across great spatial scales. For example, hurricanes in 1788 and 1821 and an ice storm in 1921 were associated with disturbance peaks observed in these decades across study areas in northwestern and southwestern Massachusetts. Interestingly, there was little synchronicity in disturbance patterns even in sites located in close proximity to each other during these events indicating the patchy, low intensity nature of these disturbances on the landscape.

How do old-growth forests compare to second-growth?

Old-growth forests exhibited a higher degree of structural complexity compared to second-growth forests. In particular, coarse woody debris (CWD) volume in old-growth forests was composed mainly of hemlock and spruce and was four times higher (135 m^3/ha) compared to second growth CWD (33 m^3/ha) that was primarily hardwood species. In addition, average snag diameter and density of large snags (> 35 cm dbh) were significantly higher in old-growth forests. There was also a wide range of structural variation among old-growth areas. Rotated sigmoid and reverse J-shaped live tree size distributions were generally found in study areas experiencing moderate to high average levels of canopy disturbance over the past 130 years in contrast to the even-aged, bell-shaped size distribution of second-growth forests that originated following logging in the late 1800 (Figure 2).

Conservation and Management Implications

Old-growth forests have long been conservation priorities due to their unusual ecosystem characteristics and value for scientific study. Many of the old-growth areas utilized in this study were designated as core components of large, state-owned forest reserves providing permanent protection for these unique ecosystems. As a result, the functioning of these old-growth areas will be greatly en-

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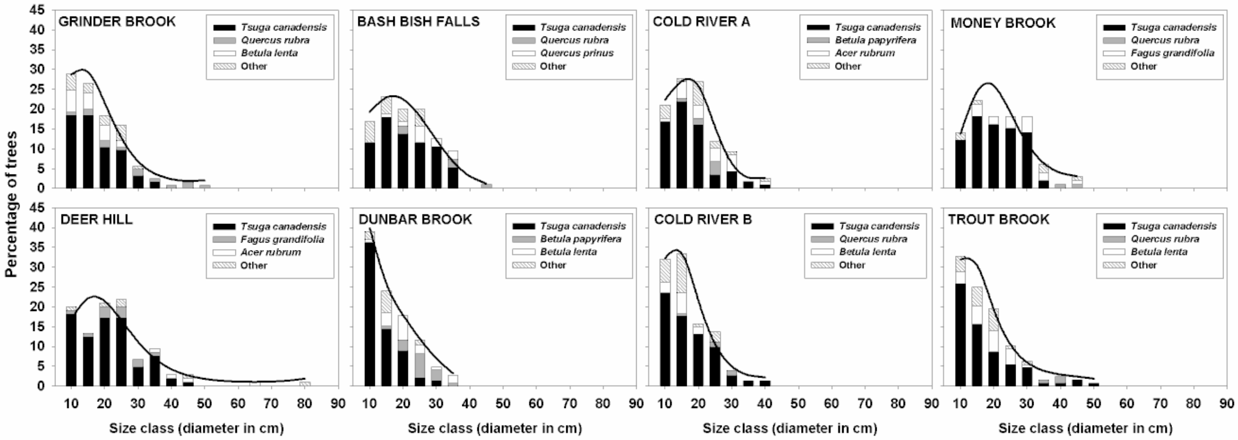

Figure 2 . Size class distributions (based on relative frequency) for all tree species combined within a) old-growth and b) second-growth eastern hemlock stands. Stands are ordered by maximum age and regression curves are superimposed on the diameter distribution. Values in parentheses represent average decadal disturbance rate (percent canopy area disturbed) from 1870-1989.

hanced as the surrounding second-growth forest matrix matures, creating large, contiguous patches of late successional forest on the landscape.

Lessons from this work can help restore old-growth elements to managed second-growth forests and can aid disturbance-based silvicultural strategies for forests in this region. For example, strategies for restoring old-growth CWD levels to second-growth stands should focus on increasing tree sizes and allow for long-term accumulations of CWD. One such approach would be to combine crown thinnings to increase coarse wood input sizes with a dispersed retention of permanent reserve trees throughout the management area.

The reconstructed disturbance frequencies can also be used silviculturally to establish the area of canopy gaps created at each stand entry over a given rotation. For example, the average disturbance frequency across old-growth areas in this study was 0.5 % per year representing an average return interval of 200 years. If a given stand was managed by emulating this disturbance rate on a 20-year cutting cycle, harvest gaps would be created in 10% of the stand during each entry. If higher disturbance rates were common to certain sites, then they could be employed to regenerate intolerant species or create early successional patches.

[Results are from Anthony D'Amato's recently completed Ph.D. dissertation at the University of Massachusetts. David A. Orwig is a forest ecologist at Harvard Forest, and served as dissertation advisor.]

Defining Old Growth *(Continued from page 9)*

in a stand's history?

The bottom line is that old-growth stands are rare and are becoming increasingly so. And as their numbers go down, their value goes up. Because of their importance, we need to know what we have, what their characteristics are, what stands may be similar to old growth, etc. To do this, we need to have useful definitions at the outset. If we wait too long in hopes of defining perfect sets of criteria and associated thresholds, those criteria will only define what once was but is no more.

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