Forest Landscape Baselines NO. 3

Brief Progress and Summary Reports 1993

"DEFINITIONS OF OLD-GROWTH EASTERN WHITE PINE AND RED PINE FORESTS FOR THE TEMAGAMI REGION OF ONTARIO"

Introduction

Before the turn of the century, "...in the country around Lakes Temagami and Lady Evelyn and to the north, an area of red and white pine of fine quality was explored and estimated to contain about 3,000,000,000 feet board measure" (Defebaugh 1906). These natural pine forests made Temagami "the best pinery in central Canada [containing] the largest body of white pine timber in the hands of the Crown in any one locality in the province" (Hodgins and Benidickson 1989). And it was "...the harvest of eastern white pine [that] generated the capital and jobs needed to nourish the settlement of Ontario, and ultimately led to the confederation of the provinces" (Aird 1985).

Following clearcut logging, however, the once extensive stands of eastern white pine declined to around 12% of the Temagami forest area by the mid-Twentieth Century (McAndrews 1978) and eventually to approximately 5% by 1978 (Day and Carter 1989). Currently, throughout all of Ontario, "only a few stands of the 'giant pine' remain" (Aird 1985). This is primarily due to a forest policy that continues to demand "...an accelerated depletion rate in order to harvest overmature timber with a minimum of further deterioration" (OMNR 1987). Although this policy of old-growth forest liquidation facilitates efficient short-term fiber production, it is rapidly causing the extinction of an ancient ecosystem of great ecological, scientific and natural heritage value. In fact, only about 0.4% of North America's original presettlement old-growth eastern white pine forests remain today (AFER 1993).

Old-growth forests maintain soil stability and water quality, retain large amounts of limiting nutrients, provide a reservoir of genetic diversity, provide unique wildlife habitat and act as carbon sinks which can help to ameliorate global warming. Tree ring analysis of old trees in natural areas has aided in the understanding of hydrologic processes, forest decline, trace metals in the environment and historical climate conditions. The study of old-growth forests has also played an important role in the development of ecological theory.

Little is known about the structure, function and development of old-growth eastern white pine ecosystems (Quinby 1991), yet, logging in Ontario continues to permanently alter the unique character of the few that remain. Thus, "working definitions are needed immediately...to guide current planning efforts, to restructure inventory procedures, and to clarify issues" (Old-Growth Definition Task Group 1986). In particular, until old-growth definitions are developed for Ontario, logging of old-growth white and red pine forest in this province will continue (OMNR 1987, OMNR 1990).

The purpose of this study is to provide definitions for old-growth eastern white pine (Pinus strobus L.) and red pine (Pinus resinosa Ait.) forest in the Temagami region of Ontario as the necessary first step in protecting these rapidly diminishing ecosystems.

Methods

The following criteria were used to select 30 stands for sampling: (1) those dominated by white and/or red pine, (2) those with the oldest trees as determined from forest stand maps and field sampling, (3) those covering the greatest area and (4) those with minimal human disturbance. All stands were found to be older than 140 years ranging in age from 178 to 378 years. Evidence of minor selective logging was observed in only three of the stands sampled. Thus, most of the oldest, largest and least disturbed eastern white and red pine stands in the Temagami region were sampled. Within each stand at least one permanently marked 50 X 20 m plot was randomly located with the singular criterion that at least two white and/or red pine >140 years of age be present within the plot. A minimum age of 140 years for both old-growth white and red pine forest was chosen because it is at that time or earlier, on average sites, that net stand growth reaches its upper limit (Ardenne 1950, Gilbert 1978, OMNR 1989).

The three major features of old-growth forests including old live trees, snags (dead standing trees) and logs (Old-Growth Definition Task Group 1986) were sampled. The overstory was defined as all trees equal to or greater than 10 cm dbh (at 1.4 meters from the ground) and was sampled by recording species and dbh. All snags equal to or greater than 10 cm dbh and taller than 2 m within the plot were identified to species when possible and measured for dbh. For each individual tree and snag sampled, basal area was calculated from dbh values. Logs with a minimum diameter of 15 cm at the larger end and a minimum length of 1 m were also inventoried. Log diameter and length measurements were used to produce log biomass estimates. Three to five of the largest pines in each plot were sampled with an increment borer to obtain estimates of oldest tree age. General features of vertical stand structure were also observed in the field.

For each stand, density estimates of old eastern white and red pine trees were obtained using a Carl Zeiss dissecting microscope with a drawing tube at 17.5X magnification to view tree crowns on 1:15,840, 1977 black and white aerial photographic diapositives (Sayn-Wittgenstein 1978). All white and red pine crowns were identified within 100 m wide transects inscribed on the diapositives running perpendicular to the long axis of each stand such that approximately 25% of the stand was systematically sampled. As the white and red pine were identified, their crown boundaries were digitized with a Sigma Scan software package (Jandel Scientific 1989) that calculated tree crown areas. From the crown area value the average crown diameter was calculated using CD=(2)(square root of(area/3.14)).

Using the known relationship between stem diameter and crown diameter (Avery 1978), and correlations between stem diameter and age, it was possible to use crown diameter as an index to tree age. From measurements taken on the ground, significant correlations were found between stem diameter and age for white pine (r=.58; significant at .01 level) and for red pine (r=.53; significant at .01 level). Significant correlations were also found between stem diameter and crown diameter for white pine (r=.62; significant at .01 level) and red pine (r=.70; significant at .01 level). The indirect relationship between age and crown diameter, which was established through their mutual correlation with stem diameter, served as the basis for identifying old trees on aerial photographs. This was done by predicting a minimum crown diameter for old trees from the minimum stem diameter for 140 years using regression models developed from ground measurements for eastern white pine (CD=(0.1098)(DBH)+1.0902; R^2=.38) and for red pine (CD=(0.1222)(DBH)+0.9932, R^2=.50).

A 38 cm dbh lower limit was chosen for white pine because only one of 35 randomly chosen white pine was found to be younger than 140 years above this 38 cm dbh limit. Similarily, because only one of 35 randomly chosen red pine was found to be younger than 140 years above 29 cm dbh, this dbh value was chosen as the lower limit for distinquishing old red pine trees. Substituting these lower dbh limits into the regression models, a minimum crown diameter of 5.3 m was predicted for white pine and for red pine, a minimum crown diameter of 4.5 m was predicted. Because crown diameter measurements from aerial photographs are generally lower than those taken on the ground (Avery 1978), those obtained from the diapositives in this study actually represented larger crown diameters (older trees) in most cases.

Results

TABLE 1 - Preliminary Minimum Standards for Old-Growth White and Red Pine Forests in the Temagami Region of Ontario

	White Pine-Deciduous	White Pine-Mixed	White Pine-Conifer	White Pine-Red Pine	Red Pine-Conifer
Old Live Trees Density	>10 trees/ha >140 years old	>10 trees/ha >140 years old	>10 trees/ha >140 years old	>15 trees/ha >140 years old	>9 trees/ha >140 years old
Associates >1 m2/ha basal area)	sugar maple, red maple, yellow birch, white cedar	white birch, red pine, white cedar, balsam fir, red maple	red pine, white cedar, black spruce, white birch	white birch, balsam fir, white cedar, white spruce	white pine, black spruce, white cedar, white birch
Canopy	white pine emergent above deciduous	multilayered canopy	multilayered canopy	multilayered canopy	mainly a single layered canopy
Snags	all species >70/ha, >10 cm DBH and 2 m tall	all species >30/ha, >10 cm DBH and 2 m tall	all species >60/ha, >10 cm DBH and 2 m tall	all species >50/ha, >10 cm DBH and 2 m tall	all species >30/ha, >10 cm DBH and 2 m tall
Logs	23 metric tons/ha, 10 pieces/ha 51 cm diam and 8 m long	23 metric tons/ha, 10 pieces/ha 51 cm diam and 8 m long	23 metric tons/ha, 10 pieces/ha 51 cm diam and 8 m long	23 metric tons/ha, 10 pieces/ha 51 cm diam and 8 m long	23 metric tons/ha, 10 pieces/ha 51 cm diam and 8 m long

Ecological Interpretation

General criteria for old-growth eastern white and red pine forest in the Temagami region of Ontario include the following: (1) white pine - at least 10 old pine/ha, >140 years; red pine - at least 9 old trees/ha, >140 years, (2) at least 10 logs/ha, at least 25 cm diameter at the large end and at least 8 m long; (3) at least 30 snags/ha, at least 10 cm dbh and 2 m tall; and (4) minimal to no human disturbance. However, forests are highly variable and dynamic systems. Thus, care must be taken not to develop a precise definition of old-growth forest that characterizes the structure and function of what may be a transitory phenomenon. "In effect, if today's definition of old growth is too exact, it cannot serve as a model for tomorrow's old growth" (Spies and Franklin 1988).

To avoid a restrictive definition of old-growth forest with limited application the young and mature stages as well as the old-growth stage of forest development need to be characterized (Parker 1989). In addition to structural features such as old trees, snags and logs, other structural features such as heterogeneity of understory, species diversity, forest floor depth and live wood biomass should be considered (Spies and Franklin 1988). Barnes (1989) stressed that functional features such as regeneration, nutrient cycling, productivity, energy flow and gene pool dynamics should also be included in the context of the old-growth abiotic environment.

Policy Implications

These criteria can be easily and inexpensively applied by the Ontario Ministry of Natural Resources (OMNR) for identifying old-growth eastern white and red pine forest throughout central Ontario. While sites are being assessed, data could be collected to determine whether old-growth pine characteristics differ significantly from one region to another. If so, a set of regionally unique definitions could be developed and applied for the protection of these endangered ecosystems (AFER 1993). To this point in time, however, the OMNR has chosen to ignore the usefulness and applicability of these old growth definitions. Due to continuing pressure from logging and lack of provincial old-growth forest policies throughout eastern Canada, the few stands of old-growth eastern white and red pine remaining throughout their natural ranges should be located, studied and protected as quickly as possible.

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Produced by Ancient Forest Exploration & Research, www.ancientforest.org, R.R.#4, Powassan, Ontario P0H 1Z0 phone/fax (705) 724-5858; A summary report of the Old-Growth White and Red Pine Definitions Project; written by P. A. Quinby, field supervision and technical contributions by P. A. Giroux; funding provided by Dr. A. Stone, Dr. J. Hackney, the Helen McCrae Peacock Foundation, the Foster Hewitt Foundation, the Bickell Foundation, the Royal Canadian Geographical Society, the Charles Frederick Fell Charitable Trust, the George Cedric Metcalf Charitable Foundation and the Ontario Ministry of Natural Resources.