

Assessment of a Forest Stand for Old-Growth Status at Point au Roche State Park, Clinton County, New York

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ABSTRACT

Potential old-growth stands continue to be located and quantified. Although there is no generally-accepted definition of old-growth, there is a set of attributes that describe old-growth forests. The Hemlock-northern hardwood stand at Point au Roche State Park in Clinton County, New York has been proposed for old-growth classification. The composition and structure of this stand were sampled between September and November, 2008. Attributes of this stand were compared with old-growth conifer-northern hardwoods. The list of attributes included species composition of overstory and understory, maximum tree ages, stand structure, standing dead trees (snags) and fallen trees (logs). The Hemlock-northern hardwood stand in this study compared favorably with old-growth conifer-northern hardwood stands for all measured attributes except the number and size of logs on the forest floor. Although abundance of large logs is an important component of old-growth stands, the Hemlock-northern hardwood stand at Point au Roche State Park could be described as old-growth.

Keywords: old-growth; hemlock; northern hardwoods; stand composition; stand structure

INTRODUCTION

Old-growth forests are important resources for our understanding of ecosystem processes and for the preservation of biological diversity (Tyrell *et al.*, 1998). Therefore, the location and description of potential old-growth stands is necessary for their protection (Davis, 1993; Davis, 1996; Hunter and White, 1997; Kershner and Leverett, 2004). The process of inventorying old-growth stands in the eastern United States gained momentum in recent decades and new old-growth stands continue to be discovered.

Most of New York State's forests have either been cleared for agriculture or heavily cut for forest products such as timber and fuelwood (Dunwiddie, *et al.*, 1996). Remnant patches of old growth forest can be found in at least 30 counties in New York and many of these stands are less than five ha in size (Davis, 1993). Most of New York's old growth stands are in the Adirondack forest preserve. Ketchledge (1992) estimated the cumulative area of old growth in the Adirondacks at 81,000 ha. Old growth forests in the Adirondack Mountains frequently include species such as Sugar Maple (*Acer saccharum*), American Beech (*Fagus grandifolia*), Yellow Birch (*Betula alleghaniensis*), Eastern Hemlock (*Tsuga canadensis*) and White Pine (*Pinus strobus*) (Leopold *et al.*, 1988; Ketchledge, 1992; McMartin, 1994; Woods and Cogbill, 1994; Ziegler, 2000; Ziegler, 2004).

Two forest stands in eastern Clinton County, New York have potential for old growth designation. One stand is a Silver Maple (*Acer saccharinum*)-Eastern Cottonwood (*Populus deltoides*) swamp located on the Ausable River Delta of the Ausable Wildlife Management Area (Davis, 1993). Another potential old growth stand on the shoreline of Lake Champlain in Clinton County, located in Point au Roche State Park, has been described as a Hemlock-northern hardwood stand (Evans *et al.*, 2003). Edinger *et al.* (2002) provided the New York Natural Heritage Program's description for the Hemlock-northern hardwood forest ecological community type. The objectives of this study were to describe the composition and structure of the Hemlock-northern hardwood stand at Point au Roche State Park and determine its suitability for classification as old growth.

METHODS

Study Area

Point au Roche State Park is managed by the New York State Office of Parks, Recreation and Historic Preservation (OPRHP) and encompasses approximately 340 ha in the township of Beekmantown. The Park is used primarily for outdoor recreation and is visited by nearly 10,000 people annually (Evans *et al.*, 2003). Prior to being established as a State Park in 1978, the property had multiple owners and a variety of land uses.

The Park's soils are mostly fine sandy loams overlying limestone bedrock (Evans *et al.*, 2003). The Park's natural communities include open fields, shrublands, successional forests and a small (12 ha) Hemlock-northern hardwood stand on the east side of Long Point Peninsula (Evans *et al.*, 2003). The Hemlock-northern hardwood stand was used as the study area for this project.

Vegetation Sampling

A series of ten nested plots were installed systematically to sample overstory and understory woody plants, snags and logs. Live trees and snags (standing dead trees) with a diameter at breast height (Dbh) greater than or equal to 20.0 cm were sampled within circular, 0.02 ha plots (radius = 7.98 m). Using the same plot center, 0.008 ha circular plots (radius = 5.05 m) were installed to sample trees with a dbh between 5.0 and 19.9 cm. Perimeters of the circular plots were determined using a BAF-10 prism and appropriate target pole (Nyland and Remele, 1975). Tree and shrub species were recorded using a 6-letter code that consisted of the first three letters of the genus and the first three letters of the species name (Appendix A). Values for tree diameter at breast height (Dbh) were recorded to the nearest 0.1 cm.

Logs within the circumference of the 0.02 ha plots were sampled by recording the small end diameter (minimum diameter = 10.0 cm), diameter of the large end, and the log length to the nearest 0.1 m. Log diameters were measured using calipers. The stage of decomposition for each log was classified as fresh, punky or extremely punky. The species for each log was recorded if it could be determined by visual inspection. The diameters of some extremely punky logs could not be measured because of their condition. Logs were sampled if at least half of the log length was contained in the plot area.

Vegetation Data Analysis

The following variables were calculated for live trees and snags, by species:

Density (number of stems per ha) = plot average * 50 for overstory trees and snags,
= plot average * 125 for understory trees

Basal area per tree (m²) = Dbh² * 0.00007854

Dominance (basal area per ha) = plot average * 50 for overstory trees and snags,
= plot average * 125 for understory trees

Relative Density = density of a species/total density of all species * 100

Relative Dominance = dominance of a species/total dominance of all species * 100

Importance Value = relative density + relative dominance

Log density per ha = number of logs per plot * 50

Log volume (cm³) = Pi/3 (R² + Rr + r²) L

R = radius (cm) of large end

r = radius (cm) of small end

L = log length (cm)

Log volume per ha = volume per plot * 50

RESULTS

Fourteen species of woody plants, representing ten plant families, were sampled in the Hemlock-northern hardwood stand at Point au Roche State Park.

Overstory Trees

The overstory of the Hemlock-northern hardwood stand consisted of 320 trees per ha and 33.7 m²/ha basal area (Table 1). Eastern Hemlock and Green Ash (*Fraxinus pennsylvanica*) were the most important of the 11 tree species sampled in the overstory stratum. Eastern Hemlock was the dominant species in the stand with 150 trees per ha and 12.3 m²/ha basal area (average Dbh = 32.3 cm), followed by Green Ash with 55 trees per ha and 4.9 m²/ha basal area (average Dbh = 33.7 cm) (Table 1). The overstory included a few, very large Red Oak (*Quercus rubra*) trees with an average Dbh of 94.4 cm.

Table 1. Overstory trees in the Hemlock-northern hardwood stand at Point au Roche State Park.

Species Code	Density (trees/ha)	Relative Density (%)	Basal Area (m ² /ha)	Relative Dominance (%)	Importance Value
TSUCAN	150.0	46.9	12.3	36.6	83.5
FRAPEN	55.0	17.2	4.9	14.5	31.7
FRANIG	30.0	9.4	1.9	5.5	14.9
ACERUB	15.0	4.7	3.1	9.1	13.8
ACESAC	10.0	3.1	3.1	9.1	12.2
THUOCC	25.0	7.8	1.4	4.2	12.0
QUERUB	5.0	1.6	3.5	10.3	11.8
BETALL	15.0	4.7	1.1	3.2	7.9
PINSTR	5.0	1.6	1.6	4.8	6.3
ULMAME	5.0	1.6	0.7	2.0	3.6
OSTVIR	5.0	1.6	0.2	0.6	2.2
Total	320.0	100.0	33.7	100.0	200.0

Understory Trees

There were 12 species of woody plants sampled in the understory stratum of this Hemlock-northern hardwood stand (Table 2). The most important species in the understory was Eastern Hemlock, followed by Yellow Birch, Black Ash (*Fraxinus nigra*), White Cedar (*Thuja occidentalis*), Hophornbeam (*Ostrya virginiana*) and Sugar Maple (*Acer saccharum*). The understory consisted of 425 trees per ha and 3.6m²/ha basal area. Seventy-five percent of the understory tree species were represented in the overstory (Tables 1 and 2).

Table 2. Understory trees and shrubs in the Hemlock-northern hardwood stand at Point. Au Roche State Park.

Species Code	Density (trees/ha)	Relative Density (%)	Basal Area (m ² /ha)	Relative Dominance (%)	Importance Value
TSUCAN	112.5	26.5	1.1	31.4	57.9
BETALL	87.5	20.6	0.4	10.1	30.7
FRANIG	37.5	8.8	0.4	12.6	21.4
THUOCC	25.0	5.9	0.6	15.5	21.4
OSTVIR	37.5	8.8	0.4	12.5	21.3
ACESAC	37.5	8.8	0.1	3.0	11.8
ACERUB	25.0	5.9	0.2	4.2	10.1
QUERUB	12.5	2.9	0.1	3.1	6.1
FRAPEN	12.5	2.9	0.1	3.0	6.0
TILAME	12.5	2.9	0.1	2.5	5.4
BETPAP	12.5	2.9	0.0	1.3	4.3
RHACAT	12.5	2.9	0.0	0.7	3.6
Total	425.0	100.0	3.6	100.0	200.0

Standing Dead Trees

Table 3 shows that there were 60 snags per ha (6.9 m²/ha basal area) in this Hemlock-northern hardwoods stand. The four tree species with standing dead trees were Sugar Maple, Eastern Hemlock, Red Oak and White Cedar. Fifty percent of the standing dead trees were Sugar Maple, but the largest snag trees were Eastern Hemlock (Table 3).

Table 3. Standing dead trees in the Hemlock-northern hardwood stand at Point Au Roche State Park.

Species Code	Density (trees/ha)	Relative Density (%)	Basal Area (m ² /ha)	Relative Dominance (%)	Importance Value
ACESAC	30.0	50.0	1.2	18.1	68.1
TSUCAN	10.0	16.7	2.5	35.8	52.4
QUERUB	15.0	25.0	1.4	20.3	45.3
THUOCC	5.0	8.3	1.8	25.9	34.2
Total	60.0	100.0	6.9	100.0	200.0

Stand Structure

The total stand density of 745 trees per ha was distributed in the inverse-J curve characteristic of an uneven-aged stand (Figure 1). The smallest Dbh class (5.0 – 14.9 cm) had the highest stem density, with 362.5 trees per hectare, including 11 of the 14 species (Table 4). Table 4 shows that all species except White Pine were present in size classes smaller than 55 cm dbh. Six species had tree diameters larger than 55 cm, with Red Oak in the largest diameter class (Table 5). Estimates of tree ages for the largest overstory trees are contained in Table 5. Species with estimated maximum tree ages older than 200 years are Eastern Hemlock (243 years), Red Maple (*Acer rubrum*) (249 years), Sugar Maple (256 years) and Red Oak (282 years) (Table 5).

Table 4. Structure of the Hemlock-northern hardwood stand at Point au Roche State Park (Trees per Hectare).

Dbh Class (cm)	Species														Total
	Tsucan	Frapen	Franig	Acerub	Acesac	Pinstr	Thuocc	Ulmame	Querub	Ostvir	Betall	Betpap	Tilame	Rhacat	
5.0 - 14.9	100.0	12.5	25.0	25.0	37.5	0.0	0.0	0.0	12.5	25.0	87.5	12.5	12.5	12.5	362.5
15.0 - 24.9	52.5	20.0	32.5	10.0	0.0	0.0	30.0	0.0	0.0	17.5	10.0	0.0	0.0	0.0	172.5
25.0 - 34.9	80.0	20.0	5.0	0.0	0.0	0.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	125.0
35.0 - 44.9	15.0	10.0	5.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0	5.0	0.0	0.0	0.0	40.0
45.0 - 54.9	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0
55.0 - 64.9	5.0	5.0	0.0	0.0	10.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0
65.0 - 74.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
75.0 - 84.9	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0
85.0 - 94.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	5.0
Total	262.5	67.5	67.5	40.0	47.5	5.0	50.0	5.0	17.5	42.5	102.5	12.5	12.5	12.5	745.0

Table 5. Average and maximum tree diameters in the Hemlock-northern hardwood stand

Species	Sample Size	Average Dbh (cm) ¹	Maximum Dbh (cm)	Estimated Maximum Age (yrs)	Estimated Annual Rings per cm radius ²
TSUCAN	30	32.3	60.8	243	8.0
FRAPEN	11	33.7	57.7	173	6.0
FRANIG	6	28.4	41.0	123	6.0
ACERUB	3	51.3	82.9	249	6.0
CESAC	2	62.8	64.1	256	8.0
THUOCC	5	26.7	28.7	115	8.0
QUERUB	1	93.9	93.9	282	6.0
BETALL	3	30.6	43.8	131	6.0
PINSTR	1	64.1	64.1	192	6.0
ULMAME	1	41.5	41.5	125	6.0
OSTVIR	1	22.8	22.8	91	8.0

¹ Equals diameter of tree of average basal area

² Assuming 8.0 rings per cm radius for shade tolerant species and 6.0 rings per cm radius for intermediate tolerance species

.Logs

The Hemlock-northern hardwoods stand had 190 logs per ha on the forest floor, ranging from recently fallen trees to extremely punky condition, with a total measurable volume of 107.6 m³ per ha (Table 6). Of the six species with identifiable logs on the forest floor, most were White Cedar (80 logs per ha) and Eastern Hemlock had the largest volume of logs (53.2 m³/ha).

Table 6. Logs on the forest floor of the Hemlock-northern hardwood stand at Point au Roche State Park

Fresh Logs

Species Code	Logs/ha	Volume (cm ³)/log	Volume (m ³)/ha
THUOCC	35	121697.4	6.1
QUERUB	5	70948.2	3.5
TSUCAN	5	50511.6	2.5
OSTVIR	5	19554.5	1.0
Total	50		13.1

Table 6 continued
Punky Logs

Species Code	Logs/ha	Volume (cm ³)/log	Volume (m ³)/ha
TSUCAN	5.0	1013827.1	50.7
FAGGRA	10.0	420354.4	21.0
N/A	20.0	166488.0	8.3
THUOCC	35.0	39743.0	2.0
BETPAP	5.0	19172.1	1.0
Total	75.0		83.0

Extremely Punky Logs

Species Code	Logs/ha	Volume (cm ³)/log	Volume (m ³)/ha
N/A	20.0	N/A	N/A
TSUCAN	15.0	N/A	N/A
THUOCC	10.0	121558.7	6.1
N/A	20.0	107591.7	5.4
Total	65.0		N/A

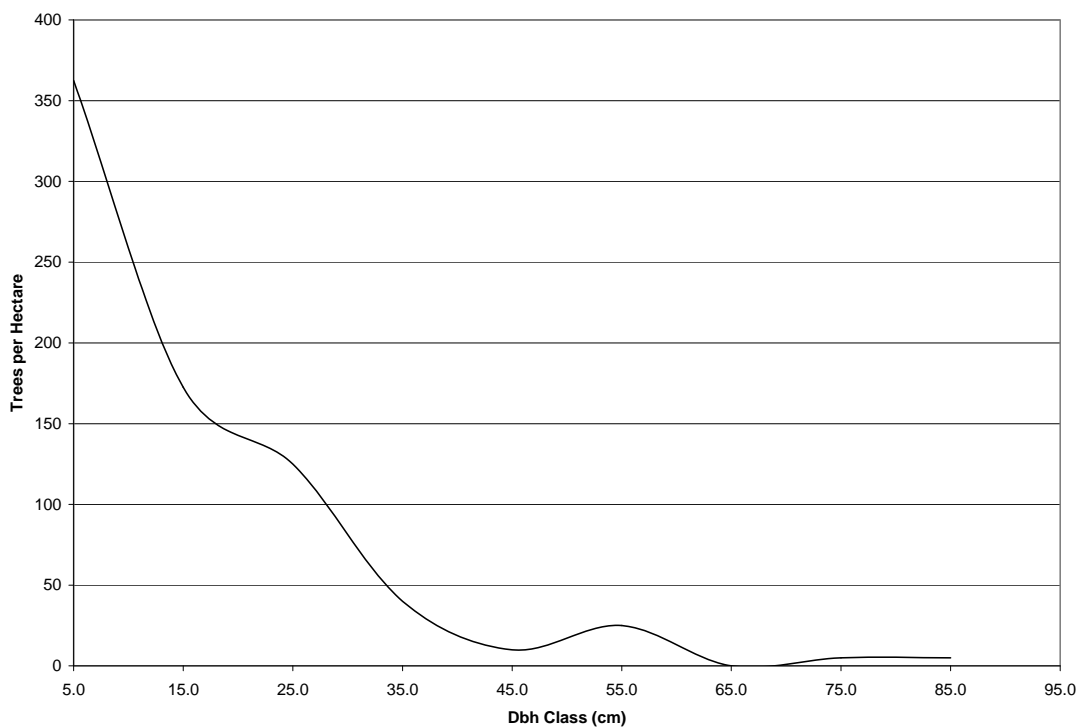


Figure 1. Stand structure for the Hemlock-northern hardwood stand at Point au Roche State Park.

DISCUSSION

Although there is no generally accepted definition for old-growth forests, this classification usually implies that the forest is “relatively old and relatively undisturbed by humans” (Hunter, 1989). Concise definitions of old-growth need to be developed for specific forest cover types yet the criteria must not be so precise that the definitions become unusable (Hunter, 1989; Tyrell, *et al.*, 1998). The following criteria are typically included in the list of attributes used to evaluate stands as old-growth in eastern forests: shade-tolerant species in all canopy layers; similarity of species in overstory and understory; overstory trees at least 200 years old; inverse-J stand structure; tree density 161 to 427 trees/ha; basal area 21 to 42 m²/ha; minimum of 10 snags per ha; and coarse woody debris (logs) of all sizes and states of decay (Hunter, 1989; Leverett, 1996; White and White, 1996).

More specifically, attributes of old-growth conifer-northern hardwood stands include: maximum age of Hemlock (140 to 536 years); maximum diameter of Hemlock (37 to 198 cm dbh); density of trees larger than 50 cm dbh (7 to 82 trees/ha); basal area of trees larger than 50 cm dbh (1.7 to 27 m²/ha); snags (15 to 238 per ha); snag basal area (0.9 to 13.6 m²/ha); log density (200 to 288 per ha); log volume (88.4 to 124.7 m³/ha) (Tyrell *et al.*, 1998).

The Hemlock-northern hardwood stand at Point au Roche State Park showed the following attributes:

- Hemlock was the most important species in the overstory and understory;
- Nine of the eleven overstory tree species, including Sugar Maple, White Cedar and Hophornbeam, were also observed in the understory;
- Estimated ages for some of the largest trees exceeded 200 years (Hemlock = 243 years, Red Maple = 249 years, Sugar Maple = 256 years Red Oak = 282 years);
- The maximum diameter of Hemlock was 60.8 cm;
- The stand structure showed an inverse-J curve;
- Total stand density was 725 trees per ha with a basal area of 37.3 m² per ha;
- Density of trees larger than 50 cm dbh was 45 trees/ha;
- Basal area of trees larger than 50 cm dbh was 14.7 m²/ha;
- The stand had 60 snags per ha with a basal area of 6.9 m²/ha;
- The stand had 190 logs per ha, with a volume of 53.2m³/ha.

This Hemlock-northern hardwood stand at Point au Roche State Park is small in size (12 ha), but there is no minimum stand size for old-growth classification (Davis 1993). Old-growth stands have shade tolerant species in the overstory and understory. Hemlock, the dominant species in both the overstory and understory of this stand, is shade-tolerant (Burns and Honkala, 1990; Harlow *et al.*, 1991). The largest Hemlock sampled in the stand had a dbh and estimated age near the low end of the range for conifer-northern hardwood old-growth stands. The age and size of Hemlock trees in this stand were also near the low end of the ranges cited for old-growth Hemlock in the Adirondacks of New York (Leopold *et al.*, 1988; Woods and Cogbill, 1994; Ziegler, 2000, 2004).

Old-growth stands display stability in species composition, with similar species in both the overstory and understory. In this stand at Point au Roche State Park, nine of the eleven overstory tree species were also found in the understory, including the shade-tolerant Sugar Maple, White Cedar and Hophornbeam. Should a natural disturbance occur in the future, tree regeneration in these canopy gaps would likely be similar to the present-day overstory species composition. The only woody species of concern for colonizing canopy gaps was the non-native shrub, Common Buckthorn (*Rhamnus cathartica*).

The structure of old-growth stands is described by the density and size of living trees, standing dead trees (snags) and fallen trees (logs). Old-growth Hemlock-northern hardwood stands are uneven-aged. The Hemlock-northern hardwood stand at Point au Roche State Park is uneven-aged, with the typical inverse-J stand structure curve. The total stand density was higher than most eastern old-growth stands, suggesting an abundance of trees in the smaller dbh size classes. The number and basal area of live trees larger than 50 cm dbh in this stand are mid-range for old-growth conifer-northern hardwood stands (Tyrell *et al.*, 1998). The number of standing dead trees in this stand is near the low end of the range for old-growth conifer-hardwoods but the basal area of snags is near the mid-range of values reported for old-growth conifer-hardwoods (Tyrell *et al.*, 1998). The logs in this stand represented all stages of decay, but the density and volume of logs were below the minimum values reported for old-growth conifer-northern hardwoods (Tyrell *et al.*, 1998).

Except for the number and size of logs on the forest floor, the attributes of this Hemlock-northern hardwood stand are above the minimum levels described for old-growth conifer-northern hardwood stands. We conclude that the Hemlock-northern hardwood stand at Point au Roche State Park could be appropriately described as “old-growth.”

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