# Establishing a Long-term, Permanent-Plot Research Program in the Catchacoma Forest, Trent Lakes, Ontario

## Research Report No. 42

**Catchacoma Forest Stewardship Committee & Ancient Forest Exploration & Research**
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**Trent Lakes & Powassan, Ontario**

by A. Folland (Fleming College), N. Woolley (Fleming College), B. Angel (AFER) and P. Quinby (AFER)

*Blanding's Turtle Shell, Pencil Creek, Catchacoma Forest*

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## 1.0 Summary

This report describes some of the values of Canada's largest known old-growth eastern hemlock forest, the Catchacoma Forest, as a research site and introduces a set of permanent plot sampling protocols to be used as a basis for future old-growth forest studies. Data collected to date provides a glimpse into the structure, composition, and possible future of the vegetation that defines the Catchacoma Forest. The intent is to expand on these first steps, continue to document and monitor old-growth conditions, and ultimately to better understand the structure, function, distribution, and value of old-growth forested landscapes (incl. wetlands, streams, etc.) as well as the effects of logging, both in the short- and long-term. Engagement in citizen science efforts and partnerships with other scientists (esp. biodiversity and ecological; aquatic, wetland, terrestrial), educators and recreationists, and with Ontario Parks is key to the progress and ultimate success of this program.

The logged plot exhibited many characteristics of old-growth eastern hemlock forest despite signs of past logging (two large trees cut). The unlogged plot was characterized by a pine-maple-hemlock forest community, which included super-canopy pines and deciduous canopy elements, both of which are common within the broader hemlock-dominated Catchacoma Forest. Pines were the largest trees recorded within both plots. Differences in site habitat conditions between the two plots, particularly the steeper slope in the unlogged plot, and the low level of logging in the logged plot are likely the causes of the lower basal area in the unlogged plot.

With additional sample plots resulting in more data, a better understanding of the ecology and attributes of eastern hemlock old-growth forest will emerge, helping to focus research questions and to identify opportunities for long-term monitoring. Data collected to date were part of a field protocol test, which will be refined and applied to further develop and improve this long-term ecological studies program.

Future potential research and education programs for the Catchacoma Forest are many and could include the following, to list just a few:

- ecology and conservation of old-growth forests,
- forest restoration and regeneration,
- monitoring and managing for invasive pests (e.g., hemlock woolly adelgid),
- values of a diverse landscape including forests, rock barrens, riparian zones, streams, wetlands, and lakes, and their interactions,
- nutrient and energy interactions along the land-water interface,
- importance and dynamics of above- and below-ground carbon sequestration and storage,
- associations between species-at-risk (e.g., Algonquin wolf, Blanding's turtle) and their habitat, and
- the value of the Catchacoma Forest to the region and beyond.

Its close proximity to Peterborough and Toronto, and to Trent University and Fleming College also increases the recreation, education, and research values of the Catchacoma Forest. There is potential to develop a self-sustaining, not-for-profit facility that could support all of these activities. We know of no such facility in Canada that focuses solely on the ecology and conservation of an old-growth forested landscape with multiple ecosystem types. Its contiguous location relative to Kawartha Highlands Provincial Park also adds value to a potential facility by being able to offer a true "wilderness experience" in a healthy park landscape that still contains its natural top predators (e.g., Algonquin wolves).

## 2.0 Introduction

This report introduces the Catchacoma Forest (685 ha) and its potential as a location for research and education focusing on the ecology and conservation of old-growth forests at an easily accessible location. We have determined that this forest is the largest known stand of eastern hemlock old-growth forest in Canada (Quinby 2019). It remains unprotected and a portion is currently allocated for contingency logging. The Forest is distinguished from the surrounding landscape by the presence of relatively undisturbed mature and old-growth forests, as well as an uncommonly high abundance of forest stands dominated by eastern hemlock (*Tsuga canadensis*).

Our studies (e.g., Quinby and CFSC 2021) show that there are many reasons to protect the Catchacoma Forest located on Crown land including perhaps most importantly, that this forest has (a) provincial-level significance based on its eastern hemlock old-growth forest (OGF) component, (b) numerous species-at-risk (ten identified to date), and (c) a high level of landscape diversity including forests, wetlands, streams and lakes many of which are in pristine condition, including a roadless area. It is now generally accepted among forest ecologists and conservation biologists that OGFs south of Ontario's Boreal Forest are extremely rare endangered ecosystems that should be protected.

With an initial goal of assessing the impacts of logging, a set of protocols was developed to establish and sample permanent plots within the Forest. In the long-term, this project also aims to adapt and apply research findings to the protection and restoration of OGFs in other parts of central Ontario. The protocols have been developed with consideration of accessibility for the experienced, inexperienced, and citizen scientists that may be collecting data in the future. In the fall of 2021, a field test of these protocols was completed and involved sampling two inaugural plots. Youth Leadership in Sustainability students from Peterborough, Ontario, led by teacher Cam Douglas, assisted in the collection of these field data. We report on the "preliminary" results here.

### 2.1. What is the Catchacoma Forest?

The Catchacoma Forest is the largest known old-growth eastern hemlock forest in Canada, at approximately 685 ha with trees upwards of 375 years old (Quinby and YLS 2021). It lies within a parcel of Crown land adjacent to the NW section of Kawartha Highlands Provincial Park (Figure 1) and contains multi-use trails and evidence of past forest harvesting. Logging appears to be limited to western sections, including logging in 1988 and 1989 as well as more recently during the winters of 2019-2020 and 2020-2021 (Quinby and CFSC 2021). No other documented commercial logging history within the Catchacoma Forest is known to AFER.

With its designation as general use Crown land, the Catchacoma Forest is not protected from logging. The Catchacoma Forest Stewardship Committee and supporters have been advocating since early 2020 for protection against future logging efforts with the goal of gaining protected status. A short-term logging moratorium (at least one year) for the Forest was announced on July 8, 2021 (Rew 2021), which will not be lifted until (1) revisions to the draft FMP are approved and (2) the province develops an acceptable field protocol to assess for the presence of old-growth forests. Studying and documenting old-growth conditions and other conservation values can help to better inform decisions (evidence-based decision-making) regarding the future of the Catchacoma Forest and its surrounding landscapes.

## 2.2. Where is the Catchacoma Forest Located?

The Catchacoma Forest is located in Trent Lakes Ontario, approximately 200 km northeast of Toronto and 60 km north of Peterborough. It occupies an area bounded by Catchacoma Lake to the south, County Road 507 to the west and Kawartha Highlands Provincial Park to the east and north. There is a parking lot and trailhead located along the east side of County Road 507 for easy access (Figure 2).

**Figure 1. Regional Setting of the Catchacoma Forest, Trent Lakes, Ontario**

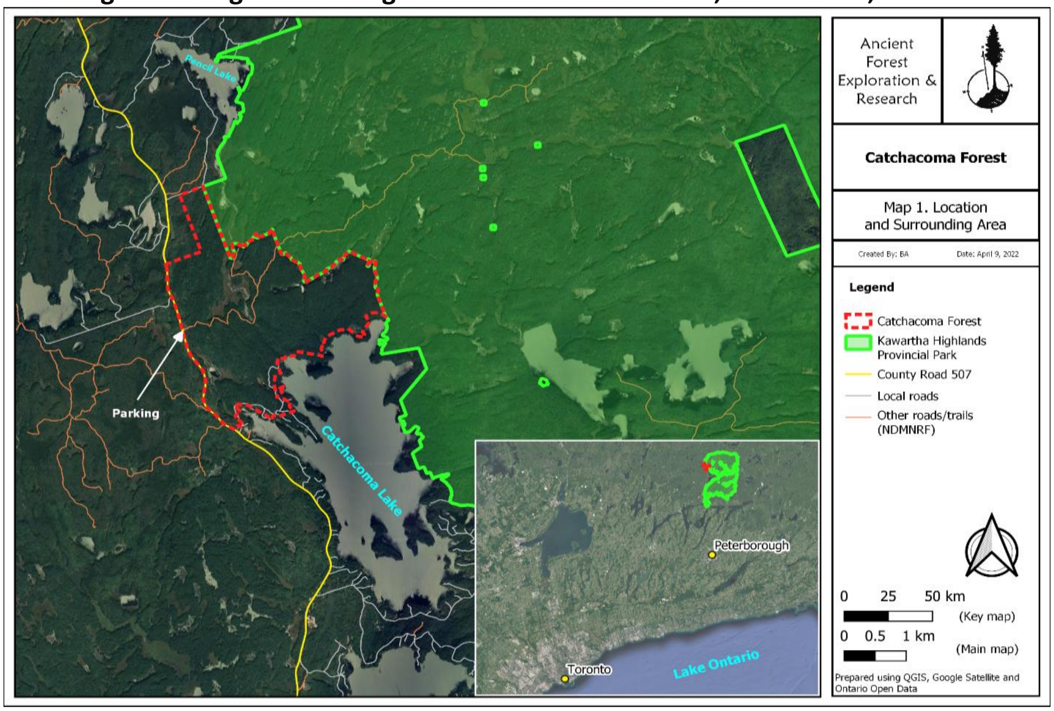
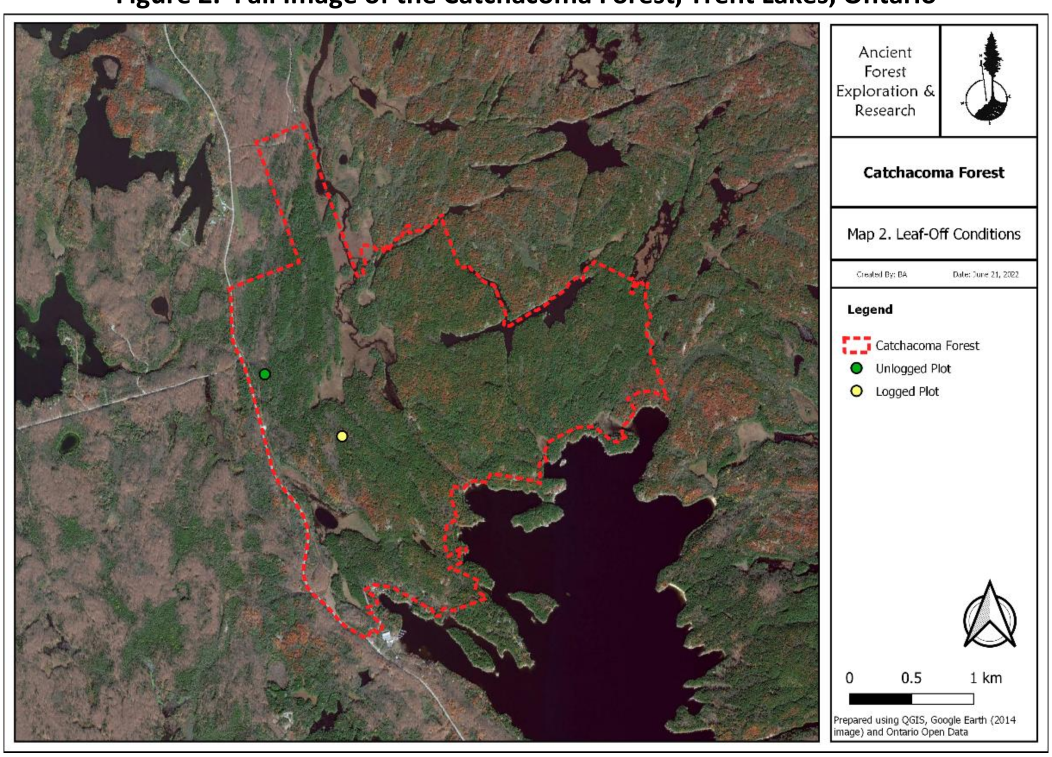



**Figure 2. Fall Image of the Catchacoma Forest, Trent Lakes, Ontario**



### 2.3. Why is the Catchacoma Forest a Valuable Site for Research?

With the increase of human activity and land development over time, forest cover in southern and central Ontario has been converted to land uses including agriculture, settlements, roads, and other infrastructure. In fact, only about 5% of southern Ontario can be considered "natural habitat". Much of the remaining forest cover has been subjected to varying degrees of logging, and intact, natural forests have become increasingly rare across the landscape (Drushka 2003, ECO 2018, Henry and Quinby 2021). The Catchacoma Forest has been less impacted by human influence and has retained the rare elements of native, undisturbed forest, wetland, stream and small lake communities. These ecosystems support high-quality wildlife habitat and are particularly important for species that are susceptible to anthropogenic disturbance.

Old-growth forests have been recognized for their value for carbon sequestration and storage (Luyssaert et al. 2008) as well as supporting biodiversity and a range of other ecosystem services such as water quality and supply (Watson et al. 2018). Identifying, studying, and protecting OGFs are important for understanding the ecology of forested landscapes, conserving the integrity of our natural spaces, and mitigating the effects of climate change.

The Catchacoma Forest is an ideal site for carrying out this kind of research and associated educational activities. Quinby and CFSC (2021) provide more discussion about potential research topics. In addition to its ecological and scientific value, the Forest is easy to access and is situated on public land. Additionally, existing trails in some portions of the site make it relatively easy to traverse and explore.

In summary, the Forest offers a unique opportunity to conduct research in a relatively ecologically intact setting that is easily accessible. In addition to facilitating traditional scientific field studies, the easy access to this site facilitates opportunities for citizen science projects and training, as well as group events, educational activities, and a variety of outdoor recreation activities.

## 3.0 Methods

The following is an overview of the methods document (Appendix 1), which provides protocols for establishing permanent sample plots in the Catchacoma Forest. Suggested quantitative methods are provided to help facilitate data summary and analyses. Blank field data sheets can be found in Appendix 2 (available upon request from pquinby@ancientforest.org).

- The predetermined plot coordinates are to be located in the field and the plot center is to be marked with a rebar stake painted yellow.
- The locations for both plots were determined using ArcGIS 10.8.1.
    - A DEM was derived from open source elevation data.
    - An attributes query was used to determine plots with similar features for initial establishment and comparison ("Aspect" > 67.5) & ("Aspect" < 112.5) & ("Slope" >= 4) & ("Slope" <= 8).
- From the plot center, a circular plot with a radius of 11.3 m (400 $m^2$) should be established and divided into 4 quadrants based on the four cardinal directions, and each quadrant should be divided in half to create 8 subplots.
- The assessment of overstory trees, snags, logs, and stumps should be completed throughout the entire plot.
- The mid-story (>0.5 m high; <10 cm dbh) should be assessed within 4 of the 8 subplots by skipping survey work within every other subplot.
- Eight 2 x 2 m quadrats are used to assess vegetation in the understory (<.5 high).
- In addition to describing the methods for vegetation sampling, Appendix 1 also addresses methods for soil sampling, wildlife observations, and for documenting other site features and conditions.

## 4.0 Results and Discussion

In-depth analysis of ecological conditions within the Catchacoma Forest and a comparison between logged and unlogged areas will require additional plot establishment, sampling and data analysis. The data from our first two plots will facilitate assessment of protocol effectiveness and will help to identify needed improvements. Vegetation sampling was divided into three categories based on vertical stratification in the forest including overstory, mid-story and understory.

The overstory includes all trees with a diameter at breast height (DBH) of at least 10 cm, the mid-story layer includes all woody stemmed plants under 10 cm DBH and over 50 cm in height, and the understory includes all vegetation under 50 cm in height. A summary of preliminary findings is presented below. Raw data can be found in Appendix 3 (available upon request from pquinby@ancientforest.org).

### 4.1. Site Landscape Features

#### 4.1.1. Logged forest (plot 1)

This plot is on a hilltop (see Fig. 2 for location), with a slope aspect of E and a slope angle of 19.5 %slope (11 deg.). Much of this site is nearly flat, with sloped portions arising from low-lying areas and raised areas from root growth around the base of trees. Tree cover is dense resulting in wet conditions due to protection from solar radiation. These conditions make it very suitable for the regeneration of hemlocks, which is reflected in the plot data. Due to the dense canopy cover and resulting low evapotranspiration, greater amounts of water are able to flow down the soil column and into the wetland area downhill.

#### 4.1.2. Unlogged forest (plot 2)

This plot is located on an upper slope (see Fig. 2 for location), with a slope aspect of E and %slope of 46.5 % (25 deg.). This plot is uphill and directly adjacent to a deciduous dominated lowland with vernal pools that was previously logged. There are also large fallen trees/snags present, which resulted in open canopy and drier soils. This plot is also located directly on bedrock, further contributing to soil sampling difficulty and could potentially be a reason for trees falling more frequently and opening up the canopy. Despite the open canopy and relative dryness, moss and other low vegetation were still abundant.

### 4.2. Overstory

#### 4.2.1. Tree species abbreviations

**BE** = American beech (*Fagus grandifolia*); **BW** = white birch (*Betula papyrifera*); **HE** = eastern hemlock (*Tsuga canadensis*); **M** = maple species (*Acer sp.*) (***Note***: Due to uncertainty in maple identification, species were pooled by genus, however it is likely that the majority of these individuals were either sugar maple (*Acer saccharum*), red maple (*Acer rubrum*), or silver maple (*Acer saccharinum*)); **OR** = red oak (*Quercus rubra*); **PW** = white pine (*Pinus strobus*)

#### 4.2.2. Logged forest (plot 1)

A basal area of 54.4 $m^2$/ha and a density of 673 stems/ha were recorded for overstory trees in the logged plot (Table 1). Additionally, the mean DBH was 29.6 cm with over 33% of trees reaching 40 cm or over (Table 2,

Figure 3). Hemlock dominance was also evident, representing approximately 84% of the basal area within the plot (Table 3, Figure 4). Based on these characteristics, this plot aligns with a densely-stocked hemlock stand (Burns et al. 1990) and is consistent with old-growth conifer stands (Keddy 1994).

**Table 1. Overstory Characteristics of Two Plots in the Catchacoma Forest**

| Plot | Basal Area ($m^2$/ha) | Density (stems/ha) | Mean DBH (cm) | Median DBH (cm) |
|---|---|---|---|---|
| Logged | 54.4 | 673.1 | 29.6 | 25.2 |
| Unlogged | 32.7 | 548.4 | 23.0 | 17.8 |

**Table 2. Overstory Tree Diameter Distribution by 10 cm Diameter Classes (%)**

| Plot | 10-19.9 cm | 20-29.9 cm | 30-39.9 cm | 40-49.9 cm | 50+ cm |
|---|---|---|---|---|---|
| Logged | 22.2 | 40.7 | 3.7 | 25.9 | 7.4 |
| Unlogged | 72.7 | 9.1 | 4.5 | 4.5 | 9.1 |

**Figure 3. Overstory Tree Diameter Distribution by 10 cm Diameter Classes for the Logged Plot (blue) and the Unlogged Plot (orange)**

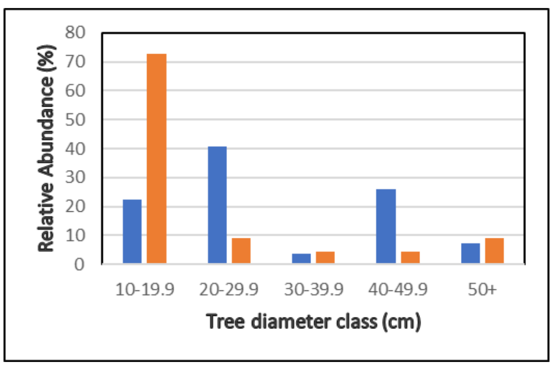
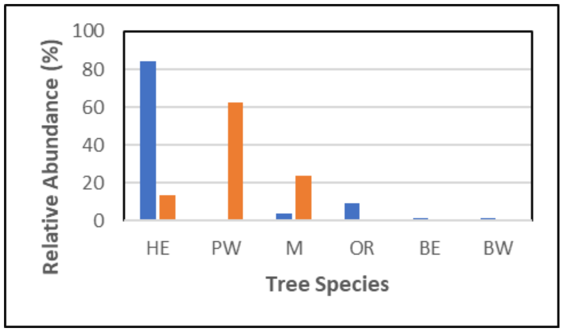



**Table 3. Relative Abundance of Overstory Tree Species**

| | Basal Area (%) by Species | | | | | |
|---|---|---|---|---|---|---|
| **Plot** | **HE** | **PW** | **M** | **OR** | **BE** | **BW** |
| Logged | 84.0 | 0.0 | 3.6 | 9.4 | 1.6 | 1.5 |
| Unlogged | 13.7 | 62.5 | 23.8 | 0.0 | 0.0 | 0.0 |

**Figure 4. Relative Abundance of Overstory Trees (basal area) for the Logged Plot (blue) and the Unlogged Plot (orange)**




This plot also contains several old-growth hemlock individuals larger than 40 cm DBH, which indicates an age of 140 years or older (Quinby 2020). Despite the two individual mature trees that were cut, the overstory structure and composition recorded in the logged plot is a good example of the old-growth hemlock forest type that defines the Catchacoma Forest. With a basal area of 54.4 $m^2$/ha, this plot far exceeds the minimum basal area requirement of 40-48 $m^2$/ha for old-growth hemlock as specified in the Bancroft Minden Forest 2021-2031 Forest Management Plan Tables (BMFC 2021).

#### 4.2.3. Unlogged forest (plot 2)

The overstory of the unlogged plot, with a basal area of 32.7 $m^2$/ha, consisted of several dominant white pines (*Pinus strobus*) along with smaller maple (*Acer spp*.) and hemlock individuals, which is reflected in a diameter distribution skewed towards smaller trees (Table 2, Figure 3). The DBH contrast between the pines and subordinate hemlocks and maples was strong, with three white pines recorded at 67.0 cm, 60.5 cm and 47.8 cm DBH, while only three of the remaining 19 trees were over 20 cm DBH (Appendix 3).

After hemlock, white pine is one of the most common overstory tree species in the Catchacoma Forest (Quinby et al. 2020) and is commonly found in the form of super-canopy individuals (Kirk et al. 2012). Together, hemlock and pine create a conifer-dominated overstory that is clearly visible in aerial imagery taken during leaf-off conditions (Figure 2). However, significant concentrations of deciduous species such as red oak, red maple and sugar maple are found throughout the Catchacoma landscape (Quinby et al. 2020).

This plot is an example of where deciduous trees, in this case maple species, are of higher importance than hemlock, which is the dominant tree species in the stand. The basal area is lower than in the logged plot, but is still on the high end for mixed forests (Keddy 1994). The large white pines over 50 cm DBH have been classified as old-growth individuals (Quinby 2020). Overall, the basal area (32.7 $m^2$/ha) is lower than what is defined as hemlock old growth in the FMP (40-48 $m^2$/ha), but is within the range (30-34 $m^2$/ha) of consideration for old-growth hardwood selection logging (BMFC 2021).

### 4.3. Mid-story and Understory

#### 4.3.1. Logged forest (plot 1)

Even more so than the overstory, the mid-story of the logged plot is dominated by hemlock. A total of 25% of the plot supported mid-story cover, with hemlock accounting for 90% of the total (Table 4, Table 5, Table 6, Figure 3). Tree density in the mid-story was 6 times higher compared with the unlogged plot. The understory was limited to approximately one third of the plot area and was two times higher compared to the unlogged plot with moss being the dominant cover type. Understory tree cover was present over 6.3% of the plot area and was almost exclusively hemlock (Table 5, Table 6, Figure 3). The presence of hemlock in the mid-story and the understory further solidifies evidence supporting hemlock as the dominant tree species within this logged plot.

#### 4.3.2. Unlogged forest (plot 2)

The mid-story amounted to only 12.7% cover, mainly composed of hemlock (90% of the 12.7% cover). Mean total understory cover was 63% and consisted mainly of ferns and mosses. Understory tree cover was only present over 3.4% of the plot area, consisting mainly of red maple and other deciduous tree species. The low representation of hemlock in the understory agrees with the overstory composition, however the dominance of mid-story hemlock may reflect the dominance of overstory hemlock within the greater Catchacoma landscape. With roughly 10 %cover in the mid-story and almost no competition, hemlock is currently poised to enter the overstory in a few years.  This may result in a proportional increase in hemlock within the plot area in 100 to 120 years given their high shade tolerance.

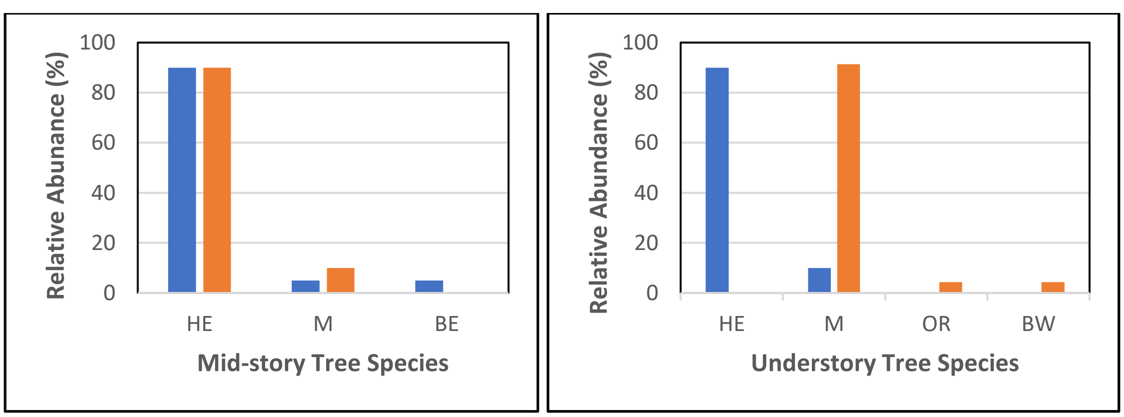
**Table 4. Mid-story and Understory Metrics by Cover Type**

| | Mid-story | | Understory (%cover) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Plot #** | **Density (stems/ha)** | **%cover** | **Total** | **Ferns** | **Fungi** | **Grasses** | **Herb/Forb** | **Mosses** | **Trees** |
| Logged | 2,368 | 25.0 | 32.5 | 1.3 | 4.4 | 0.0 | 3.1 | 17.5 | 6.3 |
| Unlogged | 399 | 12.5 | 62.4 | 25 | 1.6 | 7.6 | 2.6 | 22.6 | 2.9 |

**Table 5. Tree Species Relative Abundance for the Mid-story and Understory**

| | Tree Species Relative Abundance (%) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Mid-story | | | Understory | | | |
| **Plot** | **HE** | **M** | **BE** | **HE** | **M** | **OR** | **BW** |
| Logged | 90.0 | 5.0 | 5.0 | 90.0 | 10.0 | 0.0 | 0.0 |
| Unlogged | 90.0 | 10.0 | 0.0 | 0.0 | 91.3 | 4.3 | 4.3 |

**Figure 5. Tree Species Relative Abundance for the Mid-story and Understory for the Logged Plot (blue) and the Unlogged Plot (orange)**



### 4.4. Snags, Logs and Cut Stumps

#### 4.4.1. Logged forest (plot 1)

Seven snags were recorded in the logged plot with a combined basal area of 6.1 $m^2$/ha and a density of 174.5 snags/ha (Table 6). Four of these were American beech (*Fagus grandifolia*; see Appendix 3). Dead and dying beach trees are common in the Catchacoma Forest and elsewhere in central Ontario due to beech bark disease (McLaughlin and Greifenhagen 2012). Only two logs were recorded in the plot for a combined volume of 11.4 $m^3$/ha and a density of 49.9 logs/ha. Both logs were slightly decayed (decay class 1 or 2, see Appendix 3).

Two cut stumps were recorded in the logged plot with diameters of 50 cm and 43 cm indicating that they were likely desirable sawlogs. They were both assessed as decay class 3, meaning that sufficient time since cutting had passed for moderate levels of decay to set in. When the cut stump basal area is added to the overstory basal area, the total is 64.9 $m^2$/ha. The cut stump basal area of 8.5 $m^2$/ha accounts for only 13.5% of the total combined basal area, indicating low harvesting intensity. This assumes minimal basal area increase since cut, but it still suggests that logging was minimal in this particular plot area.

#### 4.4.2. Unlogged forest (plot 2)

No cut stumps were found in this plot, however, one large uncut stump with a diameter of 55 cm and moderate decay was observed (Table 6, Figure 6). Snag density in this plot was only 14% of the snag density in the logged plot, however, log volume in this plot was 7 times higher than in the logged plot (Table 6, Table 7, Figure 6).

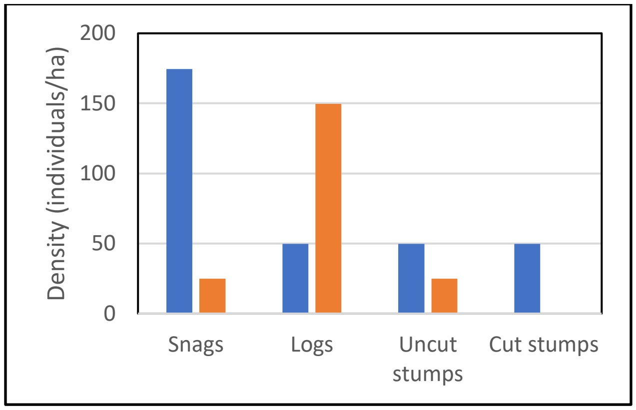
**Table 6. Snag, Logs and Stump Metrics**

| | Basal Area ($m^2$/ha) | | | Volume ($m^3$/ha) | Density (individuals/ha) | | | |
|---|---|---|---|---|---|---|---|---|
| **Plot** | **Snags** | **Uncut stumps** | **Cut stumps** | **Logs** | **Snags** | **Uncut stumps** | **Cut stumps** | **Logs** |
| Logged | 6.1 | 3.2 | 8.5 | 11.4 | 174.5 | 49.9 | 49.9 | 49.9 |
| Unlogged | 0.1 | 5.9 | 0.0 | 81.7 | 24.9 | 149.6 | 24.9 | 0.0 |

**Table 7. Snag Species Abundance**

| | Species Abundance by Basal Area (%) | | | |
|---|---|---|---|---|
| **Plot #** | **HE** | **M** | **BE** | **BW** |
| Logged | 32.8 | 6.3 | 51.9 | 8.9 |
| Unlogged | 100.0 | 0.0 | 0.0 | 0.0 |

**Figure 6. Density of Snags, Logs, and Stumps for the Logged Plot (blue) and the Unlogged Plot (orange)**




### 4.5. Cored Trees

Three hemlocks were cored in the logged plot with tree ring counts and DBH measurements of 123 yrs. (53.5 cm), 117 yrs. (35.9 cm) and 54 yrs. (15.7 cm). Ring counts were converted to 147, 141 and 78 yrs. with the addition of 24 years to account for growth up to the measured height of approximately 1.3 m (Vasiliauskas 1995). One hemlock with 60 tree rings (21.3 cm DBH) was cored in the unlogged plot (see Appendix 3), which corresponds to an age estimate of 84 years.

### 4.6. Wildlife

The presence of seven bird species (Black-capped Chickadee (*Poecile atricapillus*), Blue jay (*Cyanocitta cristata*), Brown Creeper (*Certhia americana*) Common Raven (*Corvus corax*), Downy Woodpecker (*Picoides pubescens*), Pine Siskin (*Spinus pinus*), White-breasted Nuthatch (*Sitta carolinensis*)), three mammals (Eastern Chipmunk (*Tamias striatus*) Red Squirrel (*Sciurus vulgaris*), White-tailed Deer (*Odocoileus virginianus*)), seven amphibian species (American Toad (*Anaxyrus americanus*), Eastern Newt (*Notophthalmus viridescens*), Four-toed Salamander (*Hemidactylium scutatum*), Green Frog (*Rana clamitans*) Red-backed Salamander (*Plethodon cinereus*), Spring Peeper (*Pseudacris crucifer*), Wood Frog (*Lithobates sylvaticus*)) and one arachnid species (Wolf Spider (*Lycosidae spp.*)) were recorded during data collection in both plots (see Appendix 3 for details).

### 4.7. Soils

Soil data collection was only partially completed for the two plots. Resampling of soils at these plots will be completed to fill data gaps (see Appendix 3). The unlogged plot (#2) was located directly on top of granite bedrock, complicating soil sampling.

### 4.8. Hemlock Dominance

At the overstory, mid-story and understory levels, hemlock dominance was evident in all three of the canopy layers in the logged plot as well as within the mid-story of the unlogged plot. However, hemlock made up only 13.7% of the basal area for the overstory in the unlogged plot where white pine and maple species were both more abundant. Maple species dominated the understory of the unlogged plot.

### 4.9. Old-growth Characteristics

A variety of old-growth characteristics were documented within the two permanent plots. Large-diameter trees were present in both plots, most notably three pines in the unlogged plot (67 cm, 60.5 cm and 47.8 cm DBH) and several large hemlocks in the logged plot (eight trees over 40 cm DBH). The basal area of the logged plot (54.4 $m^2$/ha) was indicative of an old-growth hemlock stand. Basal area was lower in the unlogged plot, but was still relatively high considering the mixed deciduous-coniferous community type. Snags and logs were observed, however snags were common only in the logged plot and logs were common only in the unlogged plot. Several snags in the logged plot were young American beech individuals (see Appendix 3). These snags likely succumbed to disease rather than to old age.

### 4.10. Logged vs Unlogged

With only two plots sampled, a strong, statistically viable comparison between logged and unlogged plots cannot be made, especially considering that the plots represented two different forest community types. However, by summarizing our observations to date, we have made information available that may facilitate improvement of our permanent plot studies in this old-growth forest moving forward.

The logged plot had higher tree basal area and tree density, with a more even tree diameter distribution. In addition, snags were more common in the logged plot. In contrast, the density and volume of logs was greater in the unlogged plot. The higher levels of tree basal area and density, and higher abundance of snags in the logged plot may be related to more suitable habitat and the low level of logging in the plot. Lower basal area is typical of deciduous and mixed stands compared to conifer-dominant stands (Keddy 1994).

In addition, the %slope of the unlogged plot (46.5) was 2.4x greater than the %slope of the logged plot (19.5). This steep slope contributes strongly to lower soil water availability in the unlogged plot, thus limiting the biotic productivity of the site at a level below the productivity of the logged plot. Finally, only two large individuals were removed from the logged plot representing a small percentage of the total pre-cut basal area.

For future studies comparing logged versus unlogged plots, cut stump density should be assessed prior to plot selection in order to select plot areas with cut stump densities representing the range of logging intensity from low to high. This will allow for examination of forest responses to logging along a disturbance intensity gradient.

## 5.0 References

AFER reports are available at: https://www.peterborougholdgrowth.ca/research-reports

Bancroft Minden Forest Company Inc. (BMFC). 2021. ***Forest Management Plan for the Bancroft Minden Forest for the 10-year period from 2021 to 2031***.

Burns, et al. 1990. ***Silvics of North America: 1. Conifers; 2. Hardwoods***. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC. vol.2, 877 p.

Drushka, K. 2003. ***Canada's Forests: a History***. McGill-Queen's University Press, Montreal.

Environmental Commissioner of Ontario (ECO). 2018. Southern Ontario's Disappearing Forests. In: ***Back to Basics, Respecting the Public's Voice on the Environment***, Queen's Park, Toronto, Ontario.

Henry, M. and P. Quinby. 2021. ***Ontario's Old-growth Forests***, second edition. Fitzhenry & Whiteside, Toronto, Ontario. 271 pp.

Keddy, C. 1994. Forest structure in eastern North America. ***Information Report No. 9***, Eastern Ontario Model Forest, Ministry of Natural Resources and Forestry, Kemptville, Ontario.

Kirk, D. A., D. A. Welsh, J. A. Baker, I. D. Thompson and M. Csizy. 2012. Avian assemblages differ between old-growth and mature white pine forests of Ontario, Canada: a role for supercanopy trees? ***Avian Conservation and Ecology*** 7(1):4.

Luyssaert, S., et al. 2008. Old-growth forests as global carbon sinks. ***Nature*** 455.7210:213-215.

McLaughlin, J. A. and S. Greifenhagen. 2012. Beech bark disease in Ontario: a primer and management recommendations. ***Forest Research Note 71***. Ontario Ministry of Natural Resources, Ontario Forest Research Institute, Sault Ste. Marie, Ontario.

Quinby, P.  2019. An Inventory of Documented Old-growth Eastern Hemlock Forests in Canada. ***Forest Landscape Baselines No. 35***, Ancient Forest Exploration & Research, Powassan, Ontario.

Quinby. P. 2020. Minimum Diameters for Old-growth Trees in Ontario's Northern Temperate Forests. ***Forest Landscape Baselines No. 36***, Ancient Forest Exploration & Research, Powassan & Peterborough, Ontario.

Quinby P., T. Martens and K. Cowcill. 2020. Rapid Assessment of Old-growth Characteristics in the Catchacoma Forest. ***Preliminary Results Bulletin #9***, Ancient Forest Exploration & Research, Powassan, Ontario.

Quinby, P. and Catchacoma Forest Stewardship Committee (CFSC). 2021. Natural Heritage Values of the Unprotected Catchacoma Forest, Ontario. ***Research Report No. 41***, Ancient Forest Exploration & Research, Powassan, Ontario.

Quinby, P. and Youth Leadership in Sustainability (YLS). 2021. A Rapid Old-growth Forest Survey to Assess for Old Trees, Evidence of Logging and Coarse Woody Debris in the Heart of the Catchacoma Forest: A Citizen Science Project. ***Preliminary Results Bulletin No. 11***, Ancient Forest Exploration & Research, Powassan, Ontario.

Rew, S. 2021. ***Letter July 8, 2021: RE-Catchacoma Forest Stewardship Committee (CFSC) Request for Review of Issues Resolution Decision***.  Office of the Director, Southern Region, Regional Operations Division, Ministry of Northern Development, Mines, Natural Resources and Forestry, Peterborough, Ontario.

Vasiliauskas, S. A. 1995. ***Interpretation of age-structure gaps in Hemlock (Tsuga canadensis) populations of Algonquin Park***. Ph.D. Thesis, Department of Biology, Queen's University. 170 pp.

Watson, J., et al. 2018. The exceptional value of intact forest ecosystems. ***Nature Ecology & Evolution*** 2.4 : 599-610.