Comparing Stand Ages Using Tree Cores and Forest Resource Inventory Mapping from 1987 and 2007 in the Catchacoma Forest, Northern Peterborough County, Ontario

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by Peter Quinby, Tim Martens & Kevan Cowcill

Ancient Forest Exploration & Research

(peterborougholdgrowth.ca; ancientforest.org)

375 year-old eastern hemlock, Catchacoma Forest, photo by C. Dewar

Introduction

In March of 2019, Ancient Forest Exploration & Research began work on a one-year project to assess and describe old-growth forests (OGF) in Peterborough County funded by the Ontario Trillium Foundation. One of the most significant findings from this project was the identification of the Catchacoma Forest as Canada's largest known old-growth eastern hemlock forest (Figure 1; Quinby 2019) with an estimated size of 662 ha (1,655 ac).

Despite this finding of national significance, and despite confirmation of the common presence of old-growth features (old trees, snags, logs, low stump density; Dewar 2020, Quinby et al. 2020), the sustainable forestry licence holder (Bancroft Minden Forest Company - BMFC) and the Ministry of Natural Resources and Forestry (MNRF) ignored these standard conservation values and requests by scientists and conservationists to put a moratorium on logging this area. Instead of delaying logging in order to further investigate the natural heritage value of this forest, a significant portion (~25 ha; ~62 ac) of this unique and valuable forested landscape was logged during fall and winter of 2019-20. An adjacent area of similar size is scheduled for logging during the fall and winter of 2020-21.

One of the arguments made by both the BMFC and the MNRF in choosing to log this unique and endangered landscape is that the Forest Resource Inventory (FRI) mapping for the site does not support the old-growth forest designation. They have confirmed that this mapping is the only source of site information they have used and that they have not collected any field data to support their assertion. However, empirical studies have shown that FRI mapping is plagued by inaccuracies.

For example, Thompson et al. (2007) found that 83 of 129 (64%) of boreal forest stands were incorrectly classified by species composition. Similarly, for 136 stands further south in the Nipissing District, Pinto et al. (2007) found that FRI- and field-based species composition matched in only 54% and 56% of cases using stand count and area coverage, respectively. Even lower levels of correspondence between map and field data for 119 forest stands and 40 water and wetland stands were observed within two large landscapes in the western Algonquin Park region at only 44% and 48% successful classification, respectively (Maxie et al. 2010).

In addition to species composition, the accuracy of stand age on FRI maps has also been examined. Without combining FRI age with other stand metrics, Cyr et al. (2010) found that stand age was not useful for predicting time since last fire in the Clay Belt of Ontario. Focussing on conifer forests in the western United States, Stevens et al. (2016) also found that stand age derived from aerial photos (Forest Inventory and Analysis (FIA) Program) does not reflect the large range of individual tree ages in the FIA plots.

Given these documented problems with FRI accuracy, the purpose of this study was to evaluate stand age estimates provided on the 1987 and 2007 FRI mapping for the Catchacoma Forest by comparing these stand age estimates to tree core age estimates taken from the same FRI stands. Growth rings on these cores were counted to estimate tree ages.

Methods

Tree cores were obtained from a total of 24 sample plots randomly distributed within FRI stands from both the 1987 and 2007 mapping throughout the 662 ha study area (Figure 2). These plots were located within 8 stands identified on the 1987 FRI mapping (Figure 3) and 22 stands identified on the 2007 FRI mapping (Figure 4). For more information on field methods see Appendix 1.

We obtained at least two cores from each plot at 4.5 feet from the ground, one from the largest tree of the dominant species in the plot and one from another tree of the dominant species about 20% smaller than the largest tree cored. Growth rings were counted after sanding each core to better expose the rings. Based on known sapling growth rates (Henry et al. 2016), 24 years were added to age estimates from hemlock cores and 15 years were added to all other species age estimates to account for growth (years) from 0 to 4.5 feet (diameter at breast height).

Results

Stand age estimates for the Catchacoma Forest obtained from (1) tree cores ranged from 120 to 224 years, with a mean of 176 years, (2) 1987 FRI mapping ranged from 108 to 188 years, with a mean of 160 years, and (3) 2007 FRI mapping ranged from 73 to 163 years, with a mean of 118 years. Comparing these means, tree core ages were 58 years higher than the 2007 FRI stand ages and 16 years higher than the 1987 stand ages, and the 1987 stand ages were 42 years higher than stand ages on the 2007 FRI mapping. Thus, compared to core ages, the 2007 FRI stand age estimates were underestimated by roughly 50%, and compared to the 1987 FRI they underestimated age by 36%.

These results support the selection of the 1987 FRI data for characterizing forest features in the Catchacoma Forest landscape. Stand ages from FRI mapping should not be used in isolation to support contentious land-use decisions that have the potential to reduce or eliminate biodiversity and ecosystem integrity through activities such as logging. Tree cores should also be obtained to more accurately determine mean stand ages and age-class distributions.

Finally, super-canopy trees were observed in 13 of the 24 (54%) plots sampled, and their presence showed no affinity for any particular stand age or age-class.

Figure 1. Location and Extent of the Catchacoma Old-growth Forest Landscape
(red line = outer boundary of OGF landscape; brown lines = watershed boundaries)

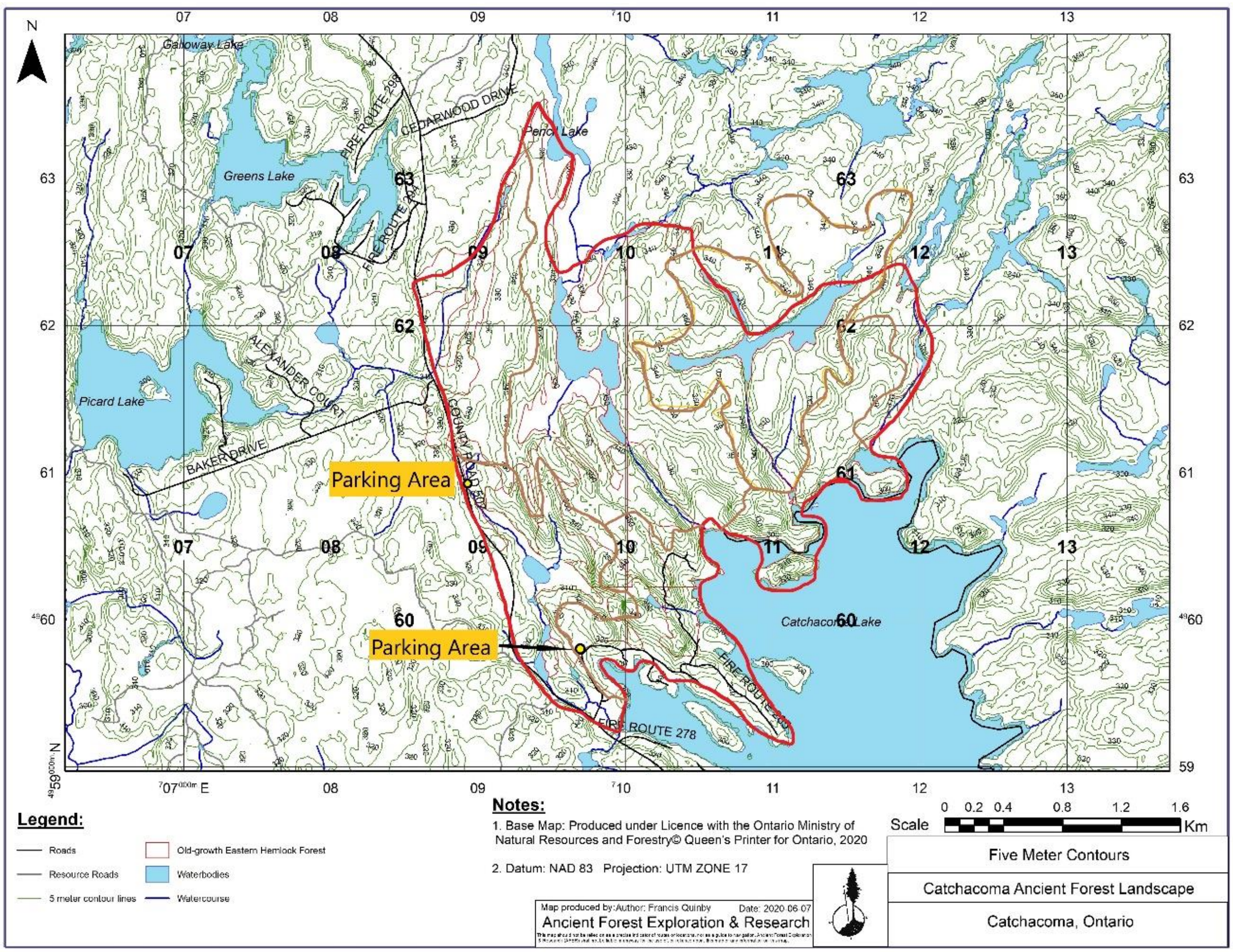

Figure 2. Location of the Field Sample Plots in the Catchacoma Forest Landscape
(square points=unlogged; round points=logged)

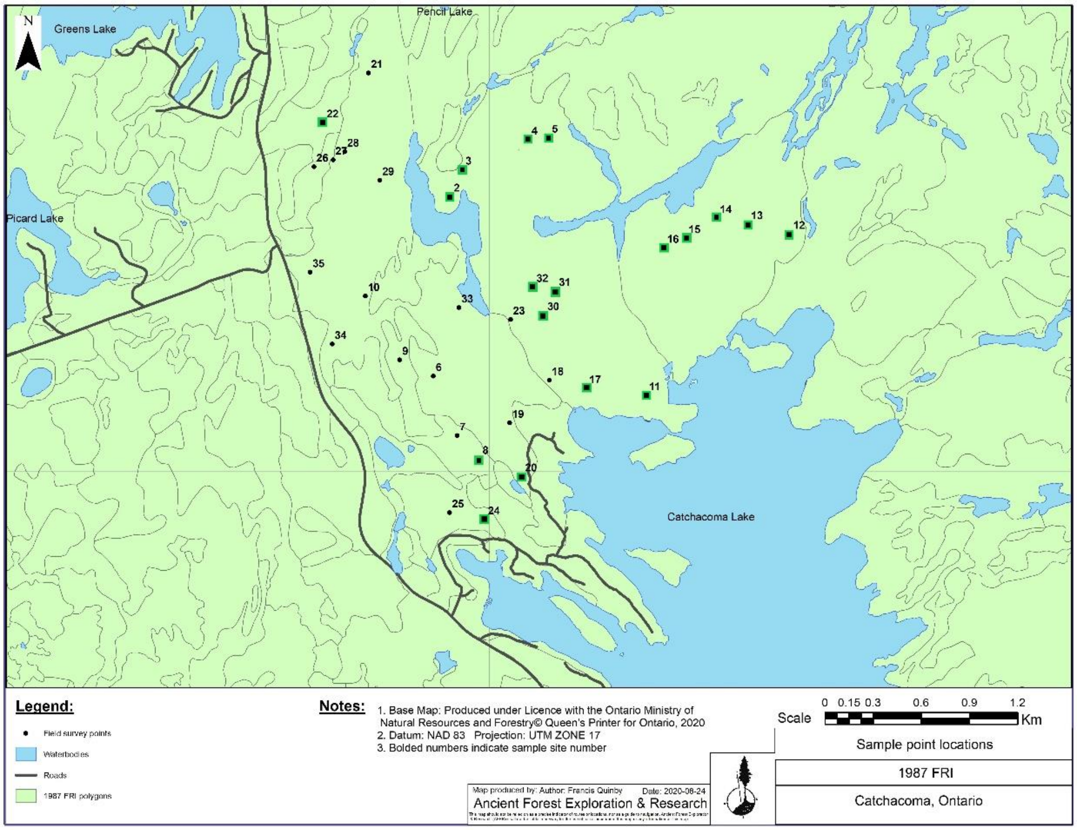

Figure 3. 1987 Forest Resource Inventory Mapping for the Catchacoma Forest
(smallest font = stand ID number; bright green = old-growth eastern hemlock forest)

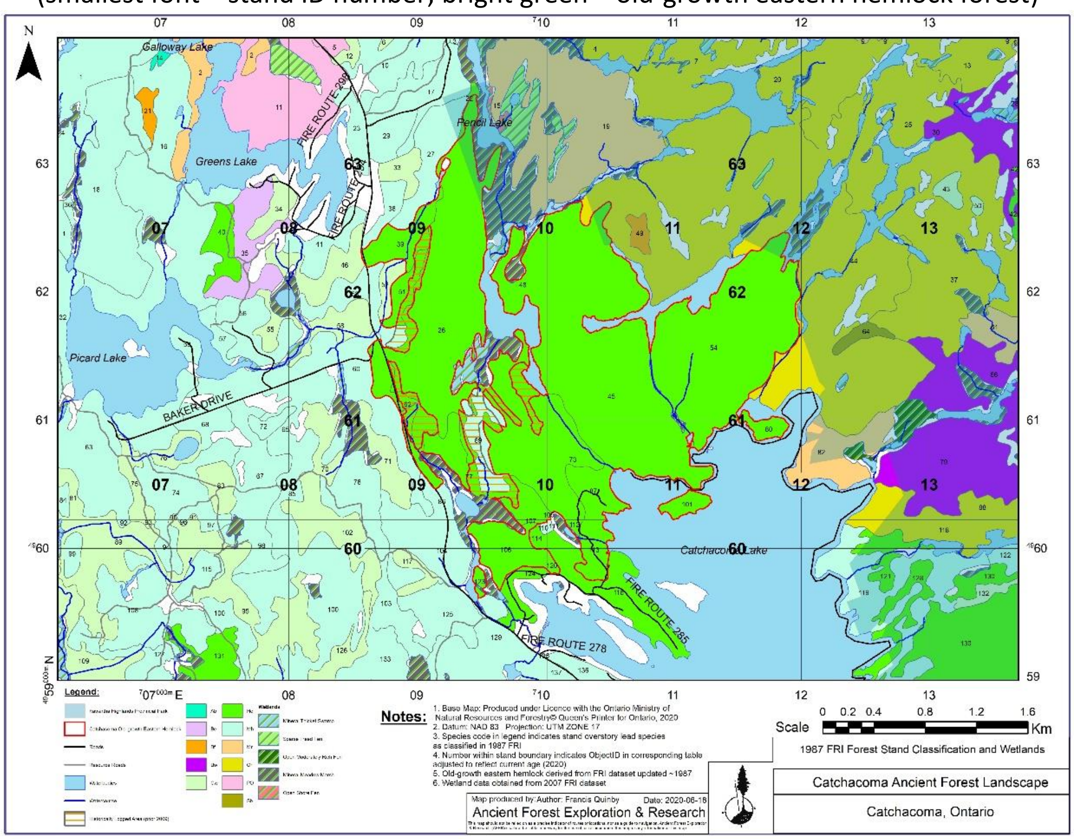

Figure 4. 2007 Forest Resource Inventory Mapping for the Catchacoma Forest
(smallest font = stand ID number; bright green = old-growth eastern hemlock forest)

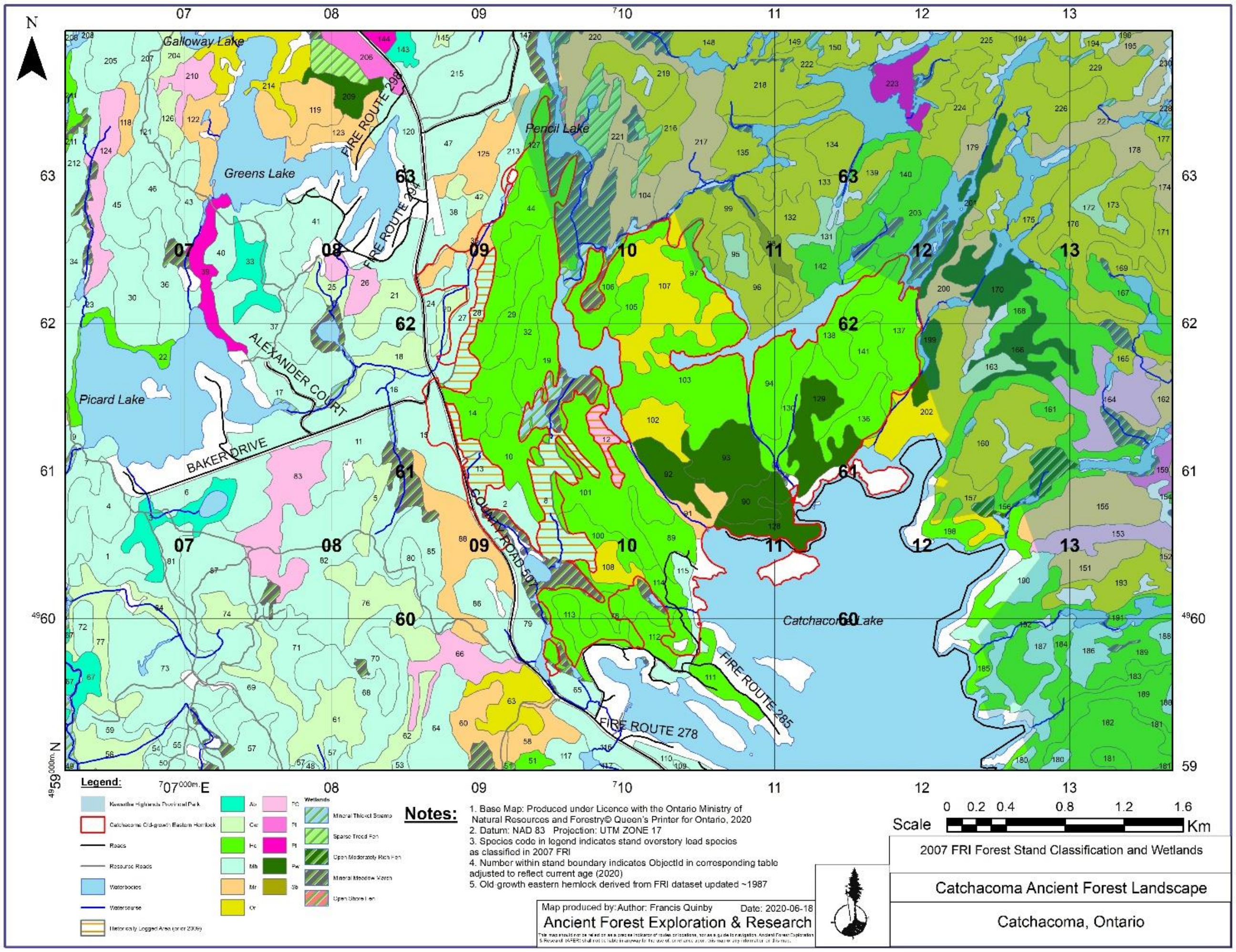

Table 1. Stand Age Comparisons in the Catchacoma Forest Using Tree Cores and Forest Resources Inventory Mapping from 1987 and 2007

Sample Plot Location (easting/northing)	Super-canopy Trees	Stand Age - Tree Cores 2020 (yrs)	Stand Age - 1987 FRI Stands 2020 (yrs)	Stand Age - 2007 FRI Stands 2020 (yrs)	1987 FRI Stand# (Fig. 3)	2007 FRI Stand# (Fig. 4)
17 T 709118 4962215	no	224	108	103	28	32
17 T 710224 4960191	no	224	177	113	73	114
17 T 709045 4962164	no	217	177	103	26	29
17 T 711438 4961800	Pw	212	148	133	54	138
17 T 709246 4961315	Pw	208	177	103	26	10
17 T 711631 4961762	Pw	204	148	133	54	141
17 T 708926 4962121	Mh	202	142	86	51	27
17 T 710435 4961346	no	199	143	113	45	103
17 T 710144 4960525	He	189	177	133	73	89
17 T 709994 4959922	Pw	189	177	113	106	78
17 T 709959 4960299	Or, Mr	189	188	73	107	108
17 T 709336 4962036	no	180	177	103	26	19
17 T 710295 4961371	Pw	175	143	123	45	102
17 T 710363 4961195	Pw	174	143	133	45	93
17 T 711109 4961615	Pw	165	148	133	54	94
17 T 709668 4960816	no	165	177	133	73	101
17 T 708902 4961463	no	164	177	103	26	14
17 T 710150 4961168	Pw	164	143	133	45	92
17 T 711243 4961676	no	149	148	113	54	130
17 T 709828 4961243	no	140	177	103	73	10
17 T 710392 4960791	Pw	133	143	133	45	92
17 T 711894 4961701	Pw	124	148	133	54	137
17 T 709770 4959965	no	124	177	163	106	113
17 T 709039 4961016	no	120	177	123	26	13
MEAN (yrs.)		**176**	**160**	**118**		
DIFFERENCE (relative to tree core ages; yrs.)			**16**	**58**		

NOTES: 1 - *Definitions*: Bd - basswood; Bf - balsam fir; Bw - white birch; By - yellow birch; Ce - white cedar; Ew - American elm; He - eastern hemlock; Iw - ironwood; Mh - sugar maple; Mr - red maple; Or - red oak; Ow - white oak; Pr - red pine; Pt - trembling aspen; Pw - white pine; Sb - black spruce. *Numbers* are relative abundance (%). *FRI* = forest resource inventory mapping (Ontario government).

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Appendix 1

Rapid Assessment Sample Checklist for Upland Old-growth Forests (OGF)

Ancient Forest Exploration & Research

(ancientforest.org; info@ancientforest.org; June 19, 2020)

Methods - Assessment locations should be distributed throughout the site (forest stand or landscape) in order to get good representation of the variety of habitat types present at the site. A forest habitat type is defined as the combination of a slope position with a slope aspect – e.g., upper slopes facing south-west, except for hilltops and flats, which have no aspect. Also, if possible, assessment samples should be distributed among the different watersheds present at the site relative to the size of each watershed (more samples in bigger watersheds). A contour map should be used to identify the location of habitat types and watershed boundaries. All features within an old-growth forest are spatially variable, thus not all assessment sample areas within an old-growth forest will have all features typical of old-growth forests.

Location and Habitat Information to Collect at each Sample Location

1. Name of OGF site (e.g., Catchacoma OGF) – record gps location
2. Sample# and date of visit
3. Surveyor's names
4. Start time and end time
5. Weather conditions
6. Radius of assessment area – pick a distance of between 10 and 20 meters depending on the ability to make accurate observations
7. Slope position: *hilltop, upper slope, mid-slope, lower slope, valley, saddle, plateau, flats*
8. Slope aspect: *N, NE, E, SE, S, SW, W, NW*
9. Slope steepness: *flat, low, medium, high*
10. Other features including: *bedrock, boulders, exposed soil, wetlands, vernal pools, etc.*
11. Forest stage of development: *young, mature, old (very little/no snags and logs), old growth (has snags and logs)*

Old-growth Features to Assess at Each Sample Location

1. Tree species present and estimated relative abundance (%) of them
2. Abundance of trees at or above the minimum old-growth age for the species: none, uncommon, common, abundant
3. Stump ID#, gps location, species, diameter at cut, stump decay class - repeat for each stump in the assessment area unless the logged area is large in which case the boundaries of the logged area should be documented with a gps
4. Forest age/mean stand age/age of oldest tree (visual estimate, ring count, or both)
5. Tree cores:
    a. obtain from at least 5 samples from each habitat type; record gps location
    b. obtain 2 cores from each sample assessment area, one from the largest tree of the dominant spp. and one from another tree of the dominant spp. but about 20% smaller than the largest tree cored
6. Logs - >10 cm diameter at the small end (describe abundance: none, uncommon, common, abundant)
7. Snags - >10 cm dbh
    a. describe abundance: none, uncommon, common, abundant
    b. woodpecker feeding holes?
    c. cavities that may support wildlife for nesting, roosting, and/or shelter?
8. Understory (0 to 3 m high)
    a. describe volume/density of vegetation as % cover
    b. list most abundant vascular plant spp. up to 5 spp.
    c. record names of rare plant spp. observed
9. Forest regeneration (species and abundance – none, uncommon, common, abundant)
10. Super-canopy trees present? If so, describe abundance (uncommon, common, abundant)
11. Evidence of human disturbance including logging, roads, skidder trails, hiking trails, etc.
12. Evidence of large gaps, wind disturbance and/or fire – describe
13. Observations of wildlife and/or evidence of wildlife use
14. Width and depth of stream/river IF APPLICABLE
15. Additional data such as bird and bat species present using recording technology would be useful

Photos and Videos

1. Take one photo in each cardinal direction at each assessment sample site
2. Take photos and/or videos of significant ecological/biological features, include gps location