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Minimum Diameters for Old-growth Trees in Ontario's Northern Temperate Forests

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"In the short-term, individual groups and societies might profit from forest destruction. However, with old-growth forest vanishing at an unprecedented pace, mankind as a whole loses the ecosystem services provided by these forests… [including their] spiritual and/or aesthetic nature, genetic resources, non-timber products, habitat for wildlife, the sequestration of carbon, the prevention of floods and erosion, to name only a few... Data on old-growth forests are generally scarce… NGOs involved in the protection of old growth or primary forests need fast and efficient survey methods and, given the land-use pressure on the remaining areas, they cannot afford to waste time." **(*Old-Growth Forests*, Wirth et al. 2009)**

Introduction

In order to facilitate the development of "fast and efficient survey methods" (Wirth et al. 2009) to assess for the presence and age of old-growth forests, we need to be able to age trees rapidly and accurately in the field. The most common aging method is to use an increment borer to obtain a core (at 4.5 ft height) from the bole of a tree. The core can then be prepared for a ring count to quantify the number of years that the tree has been growing. Unfortunately, using this method for aging trees is too slow for the rapid surveys of old growth that are required.

Thus, the purpose of this study was to use age-diameter relationships of tree species found in Ontario's northern temperate forests to identify minimum diameters for old-growth trees. This minimum diameter field tool will increase the speed of identifying old-growth trees and of surveying for old-growth forests. Since little data on minimum diameters for old-growth trees are available, tree cores should be selectively obtained during old-growth forest surveys to build up a robust dataset of age-diameter relationships for tree species that can dominate in a forested landscape. These data can then be used to refine current minimum diameters for old-growth trees much of which comes from sources outside of Ontario.

Methods

Literature providing information on the relationship between tree age and diameter was used to estimate the minimum diameter for tree species at their old-growth "age of onset", as defined in *Old-growth Forest Definitions for Ontario* (OMNR 2003) for 23 species that are common dominants in Ontario's northern temperate forests. Both primary and secondary data were used to identify tree species age-diameter relationships. Primary data were obtained from sources that produced or obtained the field data and secondary data were obtained from sources that referenced data from primary sources. For the final field tool, we have included circumference values as well as diameter values for those who do not use DBH (diameter at breast height) tapes.

The minimum old-growth diameter for seven tree species (American basswood, black ash, bur oak, red oak, silver maple, white ash, and white oak) was reduced by one-third to adjust for Ontario's more northern location and slower tree growth, relative to the more southern location associated with the source of the age-diameter data for each of the seven species (Table 1) based on Putnam and Reich (2017). Relevant data from NRCAN (2019) provides only maximum age and maximum diameter values for each species, which we used to predict minimum old-growth diameters assuming a linear relationship between age and diameter. These data issues emphasize the need to collect tree cores from these 23 species in locations that fall within the temperate forests of Ontario to establish more accurate and robust age-diameter relationships.

Results and Discussion

The minimum old-growth diameter for these 23 tree species ranged from 15 cm DBH to 60 cm DBH (Table 1). Old-growth diameter values for 14 of the 23 tree species ranged between 26 and 45 cm DBH; the values for three species were less, and the values for seven species were greater than that range. The following five diameter categories show the tree species associated with each category.

- **Minimum Diameters 15-25 cm** – *three species:* black spruce in swamps (15 cm), jack pine (25 cm), tamarack (25 cm)
- **Minimum Diameters 26-35 cm** – *eight species:* American beech (30 cm), balsam fir (30 cm), black spruce in uplands (30 cm), white cedar (30 cm), white spruce (30 cm), red maple (35 cm), sugar maple (35 cm), white birch (35 cm)
- **Minimum Diameters 36-45 cm** – *six species:* bur oak (40 cm), eastern hemlock (40 cm), poplar (40 cm), red pine (40 cm), white oak (40 cm), yellow birch (45 cm)
- **Minimum Diameters 46-55 cm** – *five species:* black ash (50 cm), black cherry (50 cm), eastern white pine (50 cm), red oak (50 cm), white ash (50 cm)
- **Minimum Diameters 56-65 cm** – *two species:* American basswood (60 cm), silver maple (60 cm)

Table 1. Minimum Diameters for Old-growth Trees in Ontario's Northern Temperate Forests (references providing original field data in bold)

Species	Minimum Old-growth Age (yrs)	Minimum Diameter (cm)	Minimum Circumference (cm)	References
American Basswood	110	60	190	Purcell 2018
American Beech	140	30	95	**Morey 1936**
Balsam Fir	70	30	95	NRCAN 2019
Black Ash (from Green Ash)	120	50	158	Purcell 2018
Black Cherry (from red oak)	120	50	158	**Morey 1936**, NRCAN 2019
Black Spruce Swamps	100	15	47	NRCAN 2019
Black Spruce Uplands	100	30	95	NRCAN 2019
Bur Oak (from White Oak)	120	40	126	Purcell 2018
Eastern Hemlock	140	40	126	**Morey 1936, Blum 1961, Henry & Quinby 2006**
Eastern White Pine	120	50	158	**Morey 1936, Gilbert 1978, Quinby 1991, Guyette and Dey 1995**
Jack Pine	120	25	79	NRCAN 2019
Poplar	90	40	126	**Brotherson et al. 1983**
Red Maple	90	35	111	**Morley 1936**
Red Oak	120	50	158	Purcell 2018
Red Pine	120	40	126	Burns & Honkala 1990, **Quinby 1991**
Silver Maple	120	60	190	Purcell 2018
Sugar Maple	140	35	111	**Blum 1961, Leak 1985**
Tamarack	90	25	79	NRCAN 2019
White Ash (from Green Ash)	120	50	158	Purcell 2018
White Birch	100	35	111	NRCAN 2019
White Cedar	110	30	95	**Henry & Quinby 2006**, Boulfroy et al. 2012
White Oak	120	40	126	**Morey 1936**, Purcell 2018
White Spruce	100	30	95	**Burgar 1961**
Yellow Birch	140	45	142	**Morey 1936, Leak 1985, Henry & Quinby 2006**

AFER's Mission and Guiding Principles

AFER is a non-profit scientific organization with a mission to carry out research and education that lead to the identification, description and protection of ancient (pristine) forested landscapes, including old-growth forests. The earth-stewardship principles that guide our work include the following.

- Many forest ecosystem types are now endangered. We consider these ecosystems and other ancient forests to be non-renewable resources, which is not consistent with the practice of mining or logging them.
- We consider biodiversity conservation needs at local, provincial, federal and international scales.
- We support the Government of Canada's official commitment to increase protected areas to 17% of the Canadian land base.
- We support the *New York Declaration on Forests* to end natural forest loss by 2030.

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