Forest Health

Position Paper

Muskoka
WATERSHED COUNCIL

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EXECUTIVE SUMMARY

Picture Muskoka and one likely pictures trees – a majestic mix of lushly green spruces and pines, blazingly colourful Sugar and Red maples, and towering tamaracks lining shorelines, trails and towns. Located in the Great Lakes-St. Lawrence Forest region, Muskoka is a transitional zone between the deciduous forests of the south and the coniferous boreal forests of the north, making its forests particularly unique. Much of Muskoka's forested area has been reforested after the intense logging in the early part of the last century, and as robust second-growth forest, Muskoka Watershed Council recognizes that maintaining and enhancing Muskoka's diverse forests is a key component of a healthy watershed and is fundamental to our community's natural and economic health.

Forests provide critical habitat to more than half of all known plant and animal species on Earth. Muskoka's forests are home to a diverse range of large and small species (including moose, deer, bears, wolves, coyotes, skunks, porcupines, hare, mice and many birds including herons, owls and chickadees) and also provide an important breeding area for many migratory birds, such as the red-shouldered hawk. Forests are also the source of diverse plants and foods from berries to maple syrup. Resource-based industries such as forestry - and the essential tourism and second-home sector of Muskoka's economy - also rely on large forested areas.

Forest trees, logs and herbaceous material slow down flood waters and act like a sponge, helping to increase the soil's ability to absorb water and to lessen the impact of flooding. Local forests support nutrient cycling, produce oxygen and also store carbon, which helps to moderate the climate and is essential to human well-being.

The majority of Muskoka's forest is located on Crown lands, with the remaining forests in private ownership. Crown land is available to all citizens for their recreational use; some forest areas are unregulated while others are actively and successfully managed. All forestry operations on Crown land in Muskoka are managed by Westwind Forest Stewardship Inc., which undertakes sustainable forest oversight by means of a Forest Management Plan approved by the Ministry of Natural Resources and Forestry.

There are several organizations within Muskoka with a mandate to maintain natural areas, including Land Trusts (including the Muskoka Conservancy, the Lake of Bays Heritage Foundation and the Georgian Bay Land Trust); Forest Reserves (including the Limberlost Forest Reserve and a portion of the Haliburton Forest); and private reserve and hunt clubs. Privately owned forests may also be protected and managed under the Province's Managed Forest Tax Incentive Program, which aims to increase landowner awareness about forest stewardship. Through good private land stewardship, the forests of the Muskoka River Watershed may continue to remain healthy, productive and enjoyable.

Regardless of ownership, however, there are threats to the current state of health: Muskoka's forests are at risk from development pressures, invasive species, calcium decline and climate change. Muskoka is growing at an average annual rate of 1% and with this growth comes increased development, sometimes to urban areas where it can contribute to compact and sustainable communities, but often in natural, forested rural areas requiring significant tree removal and fragmentation of large forested areas. Decades of acid deposition have depleted soil calcium reserves and, when combined with timber harvesting, predicted losses of calcium from soil are considerable and may ultimately threaten long-term forest health. Invasive species, coming from across the country or across the globe, threaten natural ecosystems and forest biodiversity as they often "out-compete" native species. Invasive species include pathogens that diminish forests and, upon arrival, are challenging to manage or eradicate. Muskoka's forests have to cope with fires, frequent droughts, blowdowns during intense storms, and outbreaks of both insect pests, as well as fungal, viral and bacterial pathogens. Threats such as Beech bark disease cause potential threat to wildlife, biodiversity and sustainable forestry in Ontario.

These challenges require effort from all levels of government and significant public will to support the innovative management approaches and development planning required to prevent fragmentation of forests, both public and private.

To protect the essential elements of a healthy forest ecosystem, Muskoka Watershed Council encourages:

1) **The District Municipality of Muskoka** to develop a natural areas strategy that will maintain the integrity of Muskoka's forested land;
2) **The Province of Ontario and Westwind Forest Stewardship Inc.** to continue implementing sustainable forestry practices and, where possible, retain existing Crown land; and
3) **Municipalities in the Muskoka River Watershed** to develop and implement Good Forestry by-laws including education of landowners on good stewardship.

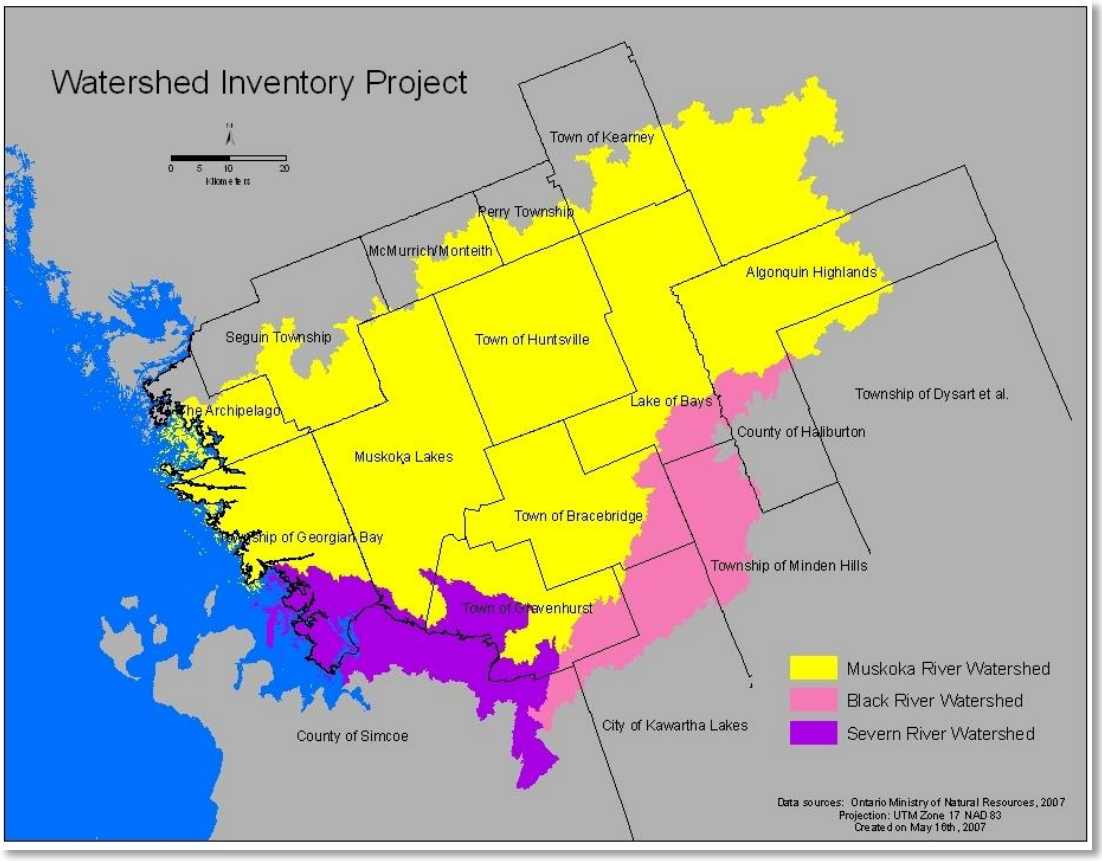
To support these local and provincial efforts, Muskoka Watershed Council will encourage and support the Province, Area Municipalities, individuals and local organizations to:

1) Develop an Invasive Species Strategy to include both:
   a) Stewardship programs on invasive species; and
   b) Implement strategies to manage Beech bark disease.
2) Develop local programs to address the issue of calcium decline in Muskoka's forests and lakes;
3) Incorporate the Ministry of Natural Resources and Forestry's forthcoming Forest Health document ("How Much (Forest) Disturbance Is Too Much") into policy and program objectives; and
4) Use best available climate change information when advising on – or choosing - species for planting, reforestation or afforestation.

INTRODUCTION

Muskoka Watershed Council (MWC) is a volunteer-based organization whose stated mission is to *Champion Watershed Health*. Health and sustainability are defined by the social, economic and environmental well-being of the area. Where potential threats to the watersheds have been identified, MWC has developed position papers based on well-researched background documents. Often the recommendations of these position papers cannot be easily implemented under the current political climate or existing law and stated policy, but MWC challenges governments, industry and the public to strive for what is desirable as well as what can be implemented in today's environment.

The focus of this paper is on the expansive forests of the Muskoka and Black/Severn River Watersheds (map 1). The large forested areas in the watersheds provide many essential services, which will be reviewed in this paper. Urban trees, while important, do not serve the same landscape level purpose and are not addressed in this paper.



Map 1: Area of Interest (source: Muskoka Watershed Inventory Project)

BACKGROUND

Muskoka is growing at an average annual rate of 1.0%.[1] This means that there will be some limited increase in development in the future. In the right place, where this new development supports existing urban areas in a compact and sustainable fashion, it can enhance the vibrant and dynamic communities of Muskoka. In the wrong place, where it does not support existing communities, destroys our large natural areas, or fragments habitat, it will detract from our communities and is not sustainable.

Ontario's Policy Framework for Sustainable Forests identifies that "large, healthy, diverse and productive forests are essential to the environmental, economic, social and cultural well-being of Ontario, both now and in the future."[2] Healthy forests are well-adapted to their growing conditions, are resilient to natural disturbance agents (e.g., fire, insect infestation, disease, and weather events), and are capable of producing an appropriate array of ecosystem services (e.g., raw materials, flood prevention, climate regulation, and soil formation).

Forests are an important component of the ecosystems of Muskoka. If Muskoka is to continue to enjoy healthy, functioning and sustainable watersheds, large natural areas comprised of forests, wetlands and rock barrens are required. Local forests support nutrient cycling, the production of oxygen and the binding of carbon. They also provide habitat for large mammals, help moderate climate, and limit the spread of disease. Resource-based industries such as forestry, and the essential tourism and second home sector of the area's economy, also rely on large forested areas.

Forests protect our lake water quality and reduce the impact of floods. Vegetation, including trees, logs, and herbaceous material slow down flood waters and act like a sponge, helping to increase the soil's ability to absorb water and to lessen the impact of flooding. By allowing precipitation to soak into the ground, the water is purified and replenishes groundwater supplies. Nutrients, sediment and other pollutants transported in overland flow to lakes are reduced in this manner (Figure 1).

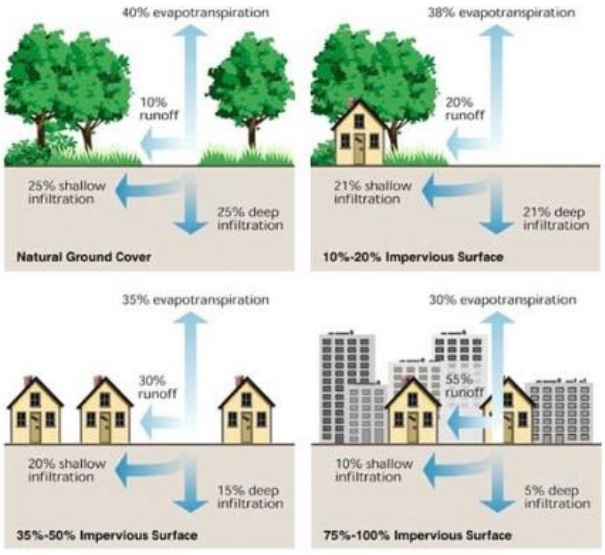


Figure 1: Stormwater flow (source: U.S. EPA)

[1] Muskoka 2013 Growth Strategy, Phase 2 Update, Watson & Associates Economists Ltd.
[2] Ontario Ministry for Natural Resources, Policy Framework for Ontario Forests, 1994 https://dr6j45jk9xcmk.cloudfront.net/documents/2826/policy-framewrk-eng-aoda.pdf

As the most biologically diverse terrestrial ecosystem, forests provide critical habitat to more than half of all known plant and animal species on Earth. Although lacking the species richness of the Carolinian Forest to the south, forests in Muskoka are comparatively wealthy in species diversity. Large animals found in our forests include moose, White-tailed deer and Black bear (and recently a very small population of elk with an introduction program). Smaller species of mammals include the Gray wolf, coyote, Red fox, Gray squirrel, Eastern chipmunk, American martin, fisher, porcupine, raccoon, Snowshoe hare, skunk and Deer mouse.

Forests in Muskoka are home to a number of year-round residents of birds such as Blue jays, Ruffed grouse and Black-capped chickadees, as well as wintering habitat for some species that breed in more northerly climates such as the Great gray owl and, although rarely encountered, the Golden eagle.

The forests of the Muskoka River Watershed are an important breeding area for many species of migratory birds, such as the Red-shouldered hawk, Cooper's hawk, Northern goshawk, Sharp-shinned hawk, Broadwing hawk, Red-tailed hawk and osprey. Great blue heron colonies can also be found in abundance in the forest near lakes and wetlands.

Forests are also the source of medicinal plants, maple syrup, mushrooms, berries, fragrances, plant dyes, garden plants and floral greens.

In summary, the forests of the watersheds are important because they help clean our air and water, store carbon, provide habitat, provide economic opportunities in the form of forestry, and support the second home and tourism industries.

CHARACTERISTICS OF MUSKOKA'S FOREST COVER

Muskoka is located in the Great Lakes-St. Lawrence Forest region. This region is a transitional zone between deciduous forests of the south and coniferous boreal forests of the north. In this region, coniferous trees such as Eastern white pine, Red pine, Eastern hemlock and White cedar commonly mix with deciduous broad-leaved species such as Yellow birch, Sugar and Red maples, Black cherry and Red oak. Eighty-five percent of Muskoka's forest cover consists of tolerant hardwood with White pine becoming more abundant towards Georgian Bay. The estimated split is 65% hardwood and 35% conifer.[3] Species more common in the boreal forest, such as White and Black spruce, Jack pine, aspen and White birch are also found here.[4]

[3] Steve Munro, Manager of Westwind Forest Stewardship Inc. Personal communication
[4] ibid

Evolution of Muskoka's Forests

The forests of the watersheds have changed over the centuries of human habitation. Prior to European settlement in the 1880s there were a number of First Nations communities that called this area home. Their influence on the forest was mainly through the use of fire to burn areas to create better browse (feed) conditions for game animals. It is thought that many of the white pine stands encountered by early settlers were the result of those fires.

Several land grants were given to people in the late 1800s to establish farms on the thin soils of the Canadian Shield. Most moved on as it was not possible to make a living on these poor agricultural sites. Evidence of these early efforts can be seen today, with often only a raised square in the forest floor that indicates an old foundation being left. Logging was the main attraction to the area, mainly for the large Eastern white pine. Several dozen sawmills were in operation in the late 1800s and into the early 1900s. The White pine stands were targeted first for the British shipbuilding market, and then to the building market of the growing cities of New York and Toronto. Log drives were common with dams being built on lakes to raise the water levels for the spring log drive. Tons of logging slash (tops) was littered across the logged over areas and were the fodder for large fires. The age class structure of the vast majority of White pine stands is a direct result of those fires and logging activities. In other areas, hardwood species invaded the sites and this has led to many forest stands, once better suited to growing pine, now growing poor quality, low value hardwoods.

Yellow birch was targeted by loggers for its veneer, especially in the 1930s and 1940s. The mosquito bomber used in World War II was built from this forest product. Hemlock was targeted for its tannins as well as to build the subway system in Toronto. High-grading (taking the best and leaving the rest) of hard maple began in earnest in the middle part of the 1900s and continued for quite some time. This has led to many hard maple stands that, although appearing healthy from a distance, have a higher amount of defect and disease than would be naturally encountered. Since the 1970s, forest management evolved from an exploitative phase to a forest improvement stage. Reverse high-grading began that has set the maple stands on a slow track to improvement and a healthier forest.[5]

Much of Muskoka's forested area has been reforested after the intense logging in the early part of the last century. As such, it does not qualify as old growth and some of its biodiversity has been lost. Nevertheless, MWC believes that healthy forests are a fundamental building block of a healthy watershed for both its natural and economic health.

[5] Westwind Forest Stewardship, Forest Management Info Forest History website http://www.westwindforest.ca/history.html

CURRENT MANAGEMENT

The Crown land-private land ratio in the watersheds is 65/35 with most of the headwater lakes of the watersheds in the Townships of Algonquin Highlands and Lake of Bays, the eastern and southern portions of the Towns of Bracebridge and Gravenhurst, and Algonquin Park, and in the western portion of the watersheds in the Township of Georgian Bay.[6]

Private Land

In Muskoka, much of our forested land is privately owned. By maintaining and managing the diversity of their forested property a landowner can provide habitat for wildlife and create a healthier forest. If the landowner is interested, their healthy forest may potentially have an economic benefit.

FOREST MANAGEMENT

Private landowners are able to reduce the property land tax on the forested part of their properties by 75% under the Managed Forest Tax Incentive Plan (MFTIP). MFTIP is a provincial program that recognizes the importance of forested lands to all Ontarians. The goal of the MFTIP program is to bring greater fairness to the property tax system by valuing forestland according to its current use. The program is designed to increase landowner awareness about forest stewardship.

Landowners who apply and qualify for the program have their properties classified and assessed as managed forest under the Managed Forest property class. The forested land is taxed at 25% of the municipal tax rate set for residential properties.

MFTIP is a voluntary program and in order to be eligible, a landowner must own at least 4 hectares (9.88 acres) of forested property, must prepare a Managed Forest Plan and have it approved by a certified Managed Forest Plan Approver, and activities on the property must be carried out in accordance with "good forestry practices" as defined in the Forestry Act. For more information on the program, visit the Ministry of Natural Resources and Forestry (MNRF) website at www.ontario.ca/environment-and-energy/managed-forest-tax-incentive-program.

In Muskoka there are 1,349 properties registered under the MFTIP program, which represents over 45,000 hectares.

[6] District of Muskoka Geomatics Department

Property owners with any size of forest are encouraged to ensure the ongoing health of their forests by having it inspected by a Forest Consultant. If there is a potential for logging, a certified tree marker can identify the trees which can or should be removed and those that should be retained for both the future value of the lumber and the health of the forest ecosystem.

Property owners should be cautious when hiring unregulated companies to undertake a forest harvest operation on their lands. In the past, unscrupulous operators have over harvested, high-graded and caused environmental damage on properties. Once the damage is done, there is very little recourse a property owner has to recover the cost of the damage. Learn more about sustainable forestry practices on the Forests Ontario website at www.forestsontario.ca.

RECREATIONAL USE OF PRIVATE FORESTS

Landowners are often not only interested in harvesting trees, but may also wish to enhance their own and others' recreational enjoyment of their property. Many property owners build trails to access the more remote sections of their properties. Before trail cutting is initiated, a plan should be developed.[7] Decisions about what the trail will be used for – walking, skiing, biking, ATVs and/or snowmobiles, etc., are important as trail standards vary depending on the use.

Properly designed trails conserve natural vegetation and wildlife, prevent environmental hazards such as erosion, and preserve the area for future generations to enjoy. A well-designed trail takes advantage of natural drainage features and natural land features such as scenic views, water crossings, cliffs, large trees and forest openings. Well-designed trails can be a source of personal pleasure as well as economic benefit given the tourism value of providing a 'nature' experience.

PROTECTION OF PRIVATE FORESTS AND SHORELINE FOREST COVER

Some areas of the forest should be protected in a natural state to support native wildlife and natural processes. There are several organizations within the watersheds with a mandate to maintain natural areas. These organizations include:

1. Land Trusts, including the Muskoka Conservancy, the Lake of Bays Heritage Foundation and the Georgian Bay Land Trust. In total, these organization are stewards of over 1,600 hectares across the watersheds.
2. Forest Reserves, including a portion of the Haliburton Forest and the Limberlost Forest Reserve. In total these two forest reserves manage over 6,000 hectares in the headwater portions of the watersheds.

[7] Muskoka Watershed Council, Trail Building Stewardship Guide

3. Private Reserves and Hunt Clubs, including the Madawaska Club, Mabel Hart Reserve and others, which steward over 800 hectares of the watersheds.

It is through good private land stewardship that the forests of the watersheds will continue to remain healthy, productive and enjoyable.

Shorelines are a special and important part of any forest. In Muskoka, a significant portion of the shoreline is privately owned and managed. The benefits of having individual trees along the shoreline are many and include shading the water to prevent overheating and cover for young fish and other aquatic organisms. The root systems provide soil stability. Dead trees and logs in shallow water provide cover and spawning areas for fish and also help to prevent impacts from wind, waves, ice and boat wake.

Resisting clear cutting a property, whether it is in the waterfront or rural area, is critical to maintaining a healthy forest. Treed lots attract interesting birds and other wildlife, maintain natural stormwater flows and soil stability, provide natural shading from summer heat, and can add interesting winter colour to the property. Where necessary, trees can be pruned to provide a desired view.

Crown Land

FOREST MANAGEMENT AND FOREST MANAGEMENT PLANNING

The forests in the watersheds are part of the MNRF French/Severn Forest Management area. Forestry operations on Crown land in Muskoka are managed by Westwind Forest Stewardship Inc. Westwind was created in 1998 and it 'orchestrates sustainable forest management in the French Severn Forest' by means of a Forest Management Plan (FMP).[8]

In February 2002, Westwind received certification from a third party auditing firm accredited by the Forest Stewardship Council (FSC). The certificate recognizes the French/Severn Forest as fulfilling all the requirements of a "Well Managed Forest".

Certification is a voluntary, market-based program that provides consumers with the power to choose products from forests that are considered to be well-managed, based on rigorous independent assessments. Westwind certification enables local logs to be marketed as FSC certified. This has an economic benefit and an environmental benefit as it ensures best management forestry practices are used.

Unlike in the past, today, detailed Forest Management Plans (FMP) are written that provide strategic direction for a 20-year period by identifying forest management issues, developing

[8] Westwind Forest Management Plan 2009-2019 http://www.westwindforest.ca/fmp.html

objectives and strategies to achieve those issues, and incorporating a monitoring program to ensure movement is made to meet those objectives. Incorporated into these 20-year plans is a component that identifies areas for forestry activities for a 5-year period as well as prescriptions on how forest values (e.g. Great blue heron colony, moose calving site, deer wintering habitat, recreation camp) are to be protected. A key component of these FMPs is the determination of the allowable harvest area (allowable cut). This represents the number of hectares by forest type that may be harvested within the five-year period. This allowable cut cannot be exceeded so that the long term sustainability of wood supply can be realized. As importantly, computer modeling provides for an analysis of wildlife habitat and landscape diversity indices so by staying within the allowable cut, habitat sustainability can also be achieved.[9]

RECREATIONAL USE OF CROWN LAND

Crown land is available to all citizens for their recreational use. Many areas, especially where there is easy road access, are heavily used in the summer for camping and ATV use. In the winter these areas are used for snowmobiling. In general, the use of Crown land is fairly low density and does not create an environmental or social issue. However, in some specific locations, the area is over used and not properly managed. This unregulated use has led to issues of excessive garbage and human waste being left in the area.

The Township of Algonquin Highlands has addressed this issue by creating the Haliburton Highlands Water Trails. The Township manages over 38 km of hiking trails, 26 km of Nordic ski trails, hundreds of campsites, portages, and canoe routes. Since 2002 they have been successfully working to preserve, protect and promote outdoor and natural recreational opportunities through a proactive, sustainable management approach.[10]

PROTECTION OF CROWN LAND

The United Nations Millennium Development Goals establish a target of 14% of the landscape secured as protected lands by 2015.[11]

In 1999, as part of the "Lands for Life" planning process, the MNRF produced "Ontario's Living Legacy Land Use Strategy" which documents land use policies for Crown Land in southern Ontario and "mid-northern" Ontario.

[9] French/Severn Forest Management Plan
[10] Township of Algonquin Highlands website http://www.algonquinhighlands.ca//?cat=trails&page=Overview
[11] Beyond 2015 UN Millennium Goals, Goal 7b Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss http://www.un.org/millenniumgoals/environ.shtml

The Lands for Life planning process had four objectives:

1. Complete Ontario's system of parks and protected areas.
2. Recognize land use needs of the resource-based and tourism industry.
3. Provide resource industries with greater land and resource certainty.
4. Enhance Ontario fishing, hunting, and other Crown Land recreation opportunities.

Ontario's Living Legacy Land Use Strategy provides broad land use classifications and outlines many new parks, conservation areas, and enhanced management areas. It outlines the intended strategic direction for the management of 39 million hectares of Crown lands and waters in an area covering 45% of the province. Approximately 61,000 acres are in the watersheds of Muskoka; in particular in the Georgian Bay and southern parts of the Township of Muskoka Lakes and Town of Gravenhurst. The goal of 14% was exceeded in the Muskoka forest.

VALUE OF MUSKOKA FORESTS

Regardless of ownership or management, the basic provisional (timber, food, and forage) and supporting (water purification, climate regulation) ecosystem services provided by forests are essential for human well-being.

Carbon Sequestration

Forests play a crucial role in mitigating climate change by serving as carbon sinks. Currently, the world's forests cover over 4 billion hectares, containing about 80% of all above ground carbon and approximately 40% of all below ground terrestrial carbon.[12]

At nearly 50% carbon by dry weight, trees store considerable amounts of carbon.[13] In 2010, six billion tonnes of carbon were estimated to be stored in Ontario's Crown managed forests.[14] The potential of a forest to act as a carbon sink depends on its age and species composition. The carbon sequestration equation for forests is neither straight forward nor easily understood. Young, fast-growing forests absorb CO_2 more rapidly than older forests. The latter may not capture any new carbon and may, in fact, release carbon as they die and decay. However, older trees can also hold large volumes of carbon as biomass over long periods of time.

Carbon is also stored in the forest soils. Typically, forest soils have a high concentration of organic carbon and are able to store twice as much carbon as the atmosphere and three times as

[12] Folegatti B.S. and M.F. Smidt Background for marketing carbon from forest growth in the US. University of Alabama, Forestry School
[13] Ibid pg. 42
[14] Ontario Ministry of Natural Resources, 2012, State of Ontario's Forests, Toronto, Queen's Printer for Ontario. pg. 43

much as the plants. On average, over two-thirds of the carbon stored in a forest is contained in the soil and associated peat deposits. This proportion varies among the forest types.[15]

Interior Forests

Forest patches which have at least a 200-metre buffer of forest around them are classified as 'interior forest'.[16] Ecological benefits of forest interior habitat are similar to that of all forests but these areas are naturally more protected from outside intrusion and form the base of the watershed's natural ability to function. Forest benefits include filtering and absorption of water into the system; absorption of large amounts of carbon dioxide that would otherwise be released into the atmosphere; and photosynthesis (plants use the energy from sunlight and nutrients from the soil and air to yield the oxygen and build the organic matter that is essential to the survival of living things).

The importance of interior forests is often equated to the health of interior forest birds. Species diversity typically increases with increasing forest cover, although the size and composition of woodlands determine what species live there. Birds are a particularly effective barometer of forest size and shape, since many of our native species need large expanses of interior habitat. Many forest-nesting birds shun edges because of the increased risk of predation or nest parasitism, inhospitable temperature and moisture conditions, or insufficient food. Edges are also more susceptible to human disturbance.

Studies undertaken in southern Ontario indicate that at least 10% of a watershed should have forest cover with a forested buffer of 100 metres and that an additional 5% of the watershed should have forest cover with a forested buffer of 200 metres. These values are considered to be minimum areas within a highly developed landscape and provide only minimal benefits with little ability to withstand any type of natural or man-induced stress. Unfortunately, there is insufficient research to establish interior forest standards in a forested environment like Muskoka. Ecosystems are dynamic, adaptive and resilient living systems, but they cannot withstand the rapid change that results from development or road construction. If the benefits that forests provide are to be maintained, they need to be kept intact.

[15] Ibid
[16] Muskoka Watershed Council. 2010 Muskoka Watershed Report Card: Background Report

Wetlands

Wetlands and wetland forests have been recognized by all levels of government as being important components of a healthy environment.[17] Wetland values are generally grouped into biological, hydrological and socio-economic benefits; however, many of the values contribute to all three broad categories. Wetlands and their surrounding area are important for the control and storage of surface water and the recharge and discharge of groundwater; maintain and improve water quality, aid in flood control, and protect shorelines from erosion; trap sediments that would otherwise fill watercourses; support and initiate complex food chains that are ultimately essential for a broad spectrum of living organisms, including humans; provide important habitat for a wide variety of plants and animal species; immobilize some contaminants and nutrients; reduce other contaminants to less-damaging compounds; assist in maintaining water quality in adjacent lakes and streams that support fish populations; and provide valuable resource products such as timber, fish and wild rice on a sustainable basis.

Tourism

As promoted by Muskoka Tourism, Muskoka has been recognized by National Geographic Traveler magazine as a special place to visit. Muskoka is one of their top 20 'Best of The World - Must-see Places' and was chosen as the #1 pick for the 'Ten Best Trips of Summer'. Just recently, Muskoka was recognized by National Geographic as one of the '100 Places That Can Change Your Child's Life'. These endorsements from an iconic magazine are testimony to Muskoka's tourism experiences and our quality of life. In the write up for each of these awards and recognition, the forests of Muskoka are a key element.[18]

Muskoka's trail network covers some 4,000 km^2 of rugged terrain. Vast forests of spruce, pine, poplar, tamarack, balsam and birch are easily accessible by some of Ontario's best hiking trail systems. Many trails lead to panoramic lookout points where sightseers and photographers can enjoy stunning scenic vistas.

Muskoka is also a paradise for wildlife lovers. Nature watchers are able to view some 250 species of birds, more than 50 types of mammals and 25 species of amphibians. Although there's no guarantee you'll see a moose or a bear, a hike through the woods will likely result in a glimpse of an otter or beaver, a woodpecker or a heron and perhaps even some deer.

Forests serve as important education, research and recreation areas, and forests are treasured places for spiritual and psychological well-being.

[17] Muskoka Watershed Council, 2010 Muskoka Watershed Report Card
[18] Muskoka Tourism website http://www.discovermuskoka.ca/

The cottage industry in Muskoka generates in excess of $600 million annually, which averages $30,000 per cottage.[19] In addition, 3 million tourist visits are generated annually, which results in approximately $391 million in spending.[20] The assessment value of commercial fixed roof accommodation is $387.1 million[21] and almost half of all jobs in Muskoka are in the Commercial/Population Related Trade (such as retail trade, accommodation and food services, education, health and social services).[22]

Harvesting

FORESTRY

The French-Severn forest encompasses the District of Muskoka and the District of Parry Sound. Over 1,000 jobs are supported by the forest industry, with logging and primary wood manufacturing jobs four times the provincial average.[23] Of the 1,000 jobs, 500 are directly related to the forestry industry, which is 6% of the regional goods-producing sector employment. 170 are indirect regional jobs and 330 are indirect provincial jobs.[24]

The French-Severn forest generates approximately $65 million annually: $7.3 million in profits and financing, $11.25 million in taxes, $10.9 million in wages and salaries, and $36.1 million in goods and services.[25]

AGGREGATES

In The District Municipality of Muskoka, sand and gravel are deposited primarily by glacial, glaciolacustrine and glaciofluvial processes. They consist predominantly of sandy materials and are mostly found in the Towns of Huntsville, Bracebridge and Gravenhurst along Highway 11, and in the Township of Lake of Bays. The selected sand and gravel resource areas of primary significance occupy an estimated total area of 554 ha. Cultural constraints and previous

[19] Muskoka Resort and Tourism Official Plan Policy Review Interim Options Report, February 20, 2013, Page i
[20] 2011 StatsCan data
[21] MPAC, Extract report as of August 2011
[22] Phase 1 of the Muskoka Growth Strategy Update
[23] Steve Munro, Operations Manager for Westwind Forest Stewardship Inc., October 2014
[24] ibid
[25] ibid

extraction reduce the area currently available to 352 ha. The selected areas contain possible sand and gravel resources of approximately 37.4 million tonnes.[26]

Hunting and Trapping

Trapping no longer provides a good living, but fur prices are reasonably good at present and there are trap lines across the watersheds. Fur bearing animals that are trapped include beaver, fisher, martin and mink. Pelts are sold at the Fur Harvesters Auction in North Bay.

Hunting is an annual ritual for many residents and visitors to Muskoka. Over 4,000 hunters participate in the three major hunting seasons in Muskoka (Table 1). This does not include statistics on Wild turkey, small game and migratory birds. Over the period of 2006 to 2013 the provincial income from bear, deer and moose season locally was $187,750.

Table 1: Hunting in Muskoka 2006-2013

Hunted Species	Average # Hunters Per Year 2006 - 2013	Average # Animals Harvested Per Year 2006 - 2013	Estimated Provincial Income Per Year 2006 - 2013
Bear	381	70	$20,575
Deer	2,489	757	$114,505
Moose	1,145	73	$52,670
Total	**4,015**	**900**	**$187,750**

Source: Ministry of Natural Resources and Forestry annual reports, https://www.ontario.ca/environment-and-energy/submit-hunting-activity-and-hunter-harvest-reports

THREATS

Muskoka's forests are healthy but require watchful stewardship as they are at risk from development pressures, invasive species, calcium decline and climate change.

[26] Gao, C. 2010. Aggregate resources inventory of District Municipality of Muskoka; Ontario Geological Survey, Aggregate Resources Inventory Paper 182, 52p.

Forest Harvesting

Forests are a key element of the watershed landscape. As you look out from the Dorset fire tower or from the lookout in Huntsville, the forest stretches out in front of you. Much of that forest is on private land and the stewardship of those lands is important to the future beauty and character of the area.

It is obvious as you look out across the landscape that private land forests have generally been well tended and the landscape has recovered from the heavy logging days of the early 19th century. For the most part, present day forest management has learned from past mistakes.

If done poorly, private land forestry could have a significant negative impact on the health of the watershed. As witnessed from those magnificent views, this is not often the case. Standard practices now include:

a. Using a selection cut method of harvesting that removes poorer trees and allows healthy trees to continue to grow for a future harvest. Over 45,000 ha of land are managed under the Managed Forest Tax Incentive Program.

b. Developing proper water crossings that reduce or eliminate "point sources" of sedimentation, water channel movement, or increase or decrease in stream flow.

c. Reducing soil disruption along waterbodies, especially within 3 metres of a waterbody.

d. Reducing excessive cutting of trees along cold or cool water streams that can increase water temperature. Limiting tree removal in these areas allows shade to continue to be provided while also maintaining trees to contribute leaves and other natural debris as nutrient sources for these systems.

e. Using more experienced foresters that reduce the damage to soil and other trees.

Invasive Species

Invasive species are plants, animals (both aquatic and terrestrial), and micro-organisms that out-compete native species when introduced outside of their natural environment and threaten natural ecosystems, the economy and society. They can come from across the country or across the globe.

Invasive species are a threat to native biodiversity in Ontario's forests. In the absence of natural predation and competition which limits their distribution and abundance

DEFINITIONS:

Introduced species – any species transported to an area outside its natural habitat.

Non-native species – an introduced species that remains in balance with native species.

Invasive species – an introduced species that out-competes native species.

in their natural habitats, introduced species may out-compete native species. Invasive species typically reproduce rapidly, damaging or destroying native species or their habitat.

The economic impact of invasive species can be severe. In Canada $187 million per year is lost in the agricultural, forestry and fishery sectors. An additional $13.3-34.5 billion per year is lost in the natural resources sector. Globally, $1.4 trillion per year is lost to invasive species.[27]

There are several unique challenges in addressing invasive species, not the least of which are the number of different species, and the pathways and vectors available to them to move around the country and the world. Many of the invasive species that are impacting Canadian natural areas originate in Europe and Asia where climate and growing conditions are similar to North America.

Pathways are the routes available for the movement of invasive species. Key pathways for terrestrial invaders include the increase in world travel, transoceanic commerce, roads, railroads and other linear disturbances on the landscape. Vectors are the vehicle by which invasive species move. Key vectors include horticultural imports, shipping pallets, and hitching a ride on recreational vehicles, clothing and pets.

It is challenging to predict where and when the next invasive species will arrive, making it very challenging to prepare or defend against the introduction. In addition, there is a significant time lag between when a non-native species is introduced to an area and when severe impacts are recognized. By the time the impact manifests itself the invasive species is often well established and very difficult to eradicate. The relationship between the timing of the introduction of a non-native species, the degree of infestation, and the cost of controlling the species is illustrated in Figure 2. As indicated, by the time the public is aware of the infestation, it is generally widespread and costly to remove or control.

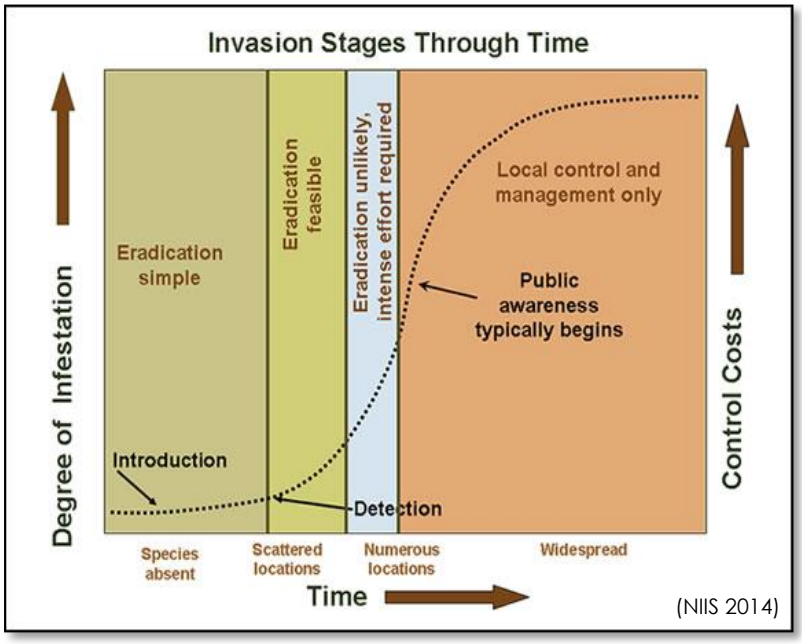


Figure 2: Pattern of Introduction of Invasive Species (source: NIIS)

[27] Statistics Canada, 2011

INVASIVE SPECIES STRATEGY

In order to prevent the introduction and spread of invasive species an Invasive Species Strategy should be developed and implemented at the District level. Any Invasive Species Strategy must be coordinated at the federal, provincial, regional and local levels to be effective. In Canada there is a Strategy addressing invasive species at both the federal and provincial levels.

Identify and Assess the Risks

The first step in such a strategy would be to identify and assess the risks, pathways and vectors, and points of entry for invasive species into Muskoka. The most effective method to control invasive species is to prevent them from entering the watershed or spreading from one area of the watershed to another. Locally, it is difficult to limit the movement of invasive species and it is recommended that local authorities work with federal and provincial agencies to develop appropriate:

- Blacklists and bans
- Permits and licenses
- Interception, quarantine, and treatment requirements

Monitoring

As outlined in Figure 2, early detection is essential to control a species effectively, both biologically and financially. Monitoring the occurrence of invasive species is critical to facilitate eradication prior to the species getting a local foothold. Local citizens should be encouraged to report sightings to the Invasive Species Hotline.

Identifying pathways and vectors along with hotspots and critical times of the year are also important steps in developing an effective monitoring program. For example, monitoring for most forest pests is most effective in the spring or summer when vegetation is in full growth.

Regulation and Legislation

At both the federal and provincial level legislation and regulation are required to provide a framework of rules to support invasive species management. Although there is a national and provincial Invasive Species Strategy, to date, they have not translated into legislation and regulation. Ontario is drafting legislation and plans to introduce it in the 2015 sitting of the legislature.

Public Awareness and Stewardship

Public awareness and stewardship must also be key components of any strategy. Communication on the cost of invasive species and the damage they can cause is required. Unfortunately, due to the lag time between introduction and public awareness, it is often difficult to gain public interest before the species becomes a significant issue.

Once the public is aware of a particular invasive species they often want to know exactly how they can help. Defined public awareness programs with action plans are necessary. In the longer term, communication and education programs need to encourage behavioural change. For example, ensuring ATV drivers always clean and dry their vehicle before transporting them to another site.

What can I do?

Simple actions of which all watershed residents should adopt include:

- Clean, drain, dry boats and recreational vehicles before moving them.
- When hiking, stay on trails and keep pets on a leash.
- Don't dump unwanted non-native pets or aquarium plants in the wild.
- Don't transport firewood into or out of Muskoka.
- Plant native or non-invasive plants. See Grow Me Instead: Beautiful Non-Invasive Plants for Your Garden.
- Report any sightings of invasive species to the Invading Species Hotline at 1-800-563-7711.
- Support invasive species legislation.
- Spread the word, not the species.
- Learn how to identify invasive plants, and how to effectively manage these species on your property. See The Landowner's Guide to Controlling Invasive Woodland Plants.
- Dispose of invasive plants in the garbage. Do not put them in the compost or discard them in natural areas. Discarded flowers may produce seeds.

Invasive Species in Muskoka's Forests

Westwind Forest Stewardship Inc. has identified three species of invasive plants that may be moving into the watersheds:

1. Dog strangling vine
2. Buckthorn
3. Garlic mustard

All of these invasive species tend to take over the forest floor and out-compete native plants. Garlic mustard is particularly dangerous as its low palatability and toxic cyanide production

ensure that it has no natural predators. Brought to North America from Europe, it is now spreading at a rate of 6,400 km^2/yr, which equates to an area 10 times the size of Toronto.[28]

In addition to invasive plant species, several insects and diseases continue to damage Ontario's forests. Examples of invasive insect species include:

- Emerald ash borer - not sighted in Muskoka as of 2014 but assumed to be present
- Hemlock woolly adelgid - sighted in northern areas of Muskoka[29]
- Mountain pine beetle - not yet in Muskoka as of 2014 but the infestation is moving east from the mountains and will likely impact all White pine
- European wood wasp - sighted in Bracebridge and Algonquin Park areas[30]
- Asian long-horned beetle - not yet in Muskoka as of 2014 but is in southern Ontario and will impact all trees, especially maple, and poses a threat to the maple syrup industry

Invasive diseases of concern include Butternut canker and Beech bark disease, which will kill 90-95% of beech trees and is present in Muskoka.

Recommendations:

1. Develop a Watershed Invasive Species Strategy for forests that will:
   a. Identify and assess risks
   b. Monitor new sightings
   c. Include a comprehensive education and stewardship program
2. Work with federal and provincial agencies as appropriate to manage or eradicate known occurrences of invasive species
3. Encourage the provincial government to pass Invasive Species legislation

Climate Change

Climate-driven change is not new to Ontario's forests. Twenty thousand years ago, Muskoka was under 2 km of ice, the weight of which depressed the land about 150 meters. There were no forests here. By 13,000 years ago, the ice sheet had retreated north of North Bay, but the western half of Muskoka was submerged under the enormous post-glacial Lake Algonquin, which drained eastwards through Kirkfield to the St. Lawrence.[31] Forests began to form on the eastern part of Muskoka. In the past 13,000 years, as our land has rebounded following removal of the

[28] Steve Munro, Operations Manager for Westwind Forest Stewardship Inc., October 2014
[29] ibid
[30] http://www.workingforest.com/wasp-cause-for-concern-in-southern-ontario/
[31] Clark, J.A., K.M. Befus, and G.R. Sharman, 2012. A model of surface water hydrology of the Great Lakes, North America during the past 16,000 years. Physics and Chemistry of the Earth 53–54: 61–71.

ice, Lake Algonquin has been replaced by the smaller Georgian Bay and Lake Huron and our modern forests have developed as different tree species were able to migrate north in the warming climate. Our land is still rebounding slowly.

The difference between post-Pleistocene climate change, and the climate change that is happening now and expected to continue in coming decades, is the speed at which it is occurring. Some plant species are unlikely to be able to adapt to this rapid rate of change because their capacity to move north is limited by seed dispersal. Some plant species may become extinct in Ontario because their capacity to migrate north is too limited and the environment where they currently occur will become unsuitable for them. The changing composition of species will create plant communities that differ from those we now enjoy.

The pace of climate change is sufficient that assisted migration may be required if we wish to retain well-functioning forest ecosystems. Assisted migration of tree species involves their artificial relocation through planting or seeding. MNRF is revising its guidance documents for forest managers to provide the most up-to-date information on best practices for adapting to climate change.[32]

Assisting the northward migration of tree species to follow climate envelopes is one option to promote forest adaptation to climate change, but it is not without its challenges. Climate change is bringing more variable weather and changed patterns of precipitation as well as a warmer temperature regime. Although migrated tree species may be better suited to the warmer climate they may be susceptible to the variability in weather events anticipated. They also may be less tolerant to freezing weather and not appropriately adapted to our seasonally more variable day length.

Researchers from MNRF's Ontario Forest Research Institute are examining tree genetics and the adaptive capacity of tree species by growing a range of species from various sources under controlled conditions to see how tree species respond to increasing temperature and concentrations of carbon dioxide. They will combine this information with projections of Ontario's future climate to determine how climate envelopes (the areas with suitable climate for a given tree species or ecosystem) are likely to change. This knowledge will help them to determine if tree species from further south are a better choice for Ontario, and will identify populations genetically better adapted to expected conditions.[33]

Climate change is expected to bring drier summers and more variable weather. Tree growth rates are expected to fall. Muskoka's forests will have to cope with an increased number of fires,

[32] MNRF, 2014. Five-Year Environmental Assessment Report on Forest Management April 1, 2008 – March 31, 2013. Ontario Ministry of Natural Resources and Forestry https://www.ontario.ca/environment-and-energy/five-year-environmental-assessment-report-forest-management-2008-2013

[33] Anon. 2014. Climate Ready. Ontario's Adaptation Strategy and Action Plan 2011-2013. Government of Ontario. https://www.ontario.ca/environment-and-energy/climate-ready-adaptation-strategy-and-action-plan-2011-2014

more frequent droughts, blowdowns during intense storms, and outbreaks of both newly migrated and current insect pests, fungal, viral and bacterial pathogens.

Forest fires, in particular, are an important part of the cycle of forest renewal, and an aspect complicated by our management practices. Due to the potential negative impact forest fires can have on human life and property, fires have been aggressively suppressed in the province for decades. Forest fire suppression has resulted in forests that are sometimes different from the forest that would be there without human intervention. Today, many of our forests are older with more dead and dying trees than would be there under natural conditions. Too little fire can decrease forest health by leading to increased incidence of insect infestation and disease, and the large accumulations of fuel that lead to catastrophic fire events once fire occurs. Forest fire protection activities are needed when fires threaten property or human life, but these activities need to be balanced to allow fire to remove old forest cover, dense underbrush, and debris. It is likely that the changing conditions caused by climate change will dictate some significant changes in fire management policies.

Muskoka's present-day forests are adapted to our current pattern of natural disturbances resulting from fires, severe weather, insects, and diseases. Climate change both alters the species mix that makes up the forests, and alters the regime of natural disturbances. How quickly and how well the altered forests will become adapted to the new regime is currently uncertain.

Calcium Decline

Calcium decline threatens not only our freshwater zooplankton but also our forests. Decades of acid deposition have depleted soil calcium reserves and, when combined with timber harvesting, predicted losses of calcium from soil are considerable and may ultimately threaten long-term forest health and productivity and lead to negative impacts on lakes.[34]

Forests are a major source of calcium. Tree bark is composed of 3% calcium with wood and foliage composed of another 1%.

Low calcium levels can stress trees. As calcium is leached from the soil and needle membranes, trees have decreased cold tolerance and root function is impaired. Calcium is on the decline in our fresh waters[35] and this is seriously affecting crustacean zooplankton. Scientific evidence indicates this decline is primarily due to acid deposition changes. There is research investigating the impact of forestry practices in relation to this decline, as the calcium deposition into lakes is also dependent upon trees decaying on the forest floor. If, in the process of harvesting, all of the

[34] Timber Harvesting and the Health of our Lakes: The Calcium Story by Dr. Shaun Watmough. Lecture hosted by Muskoka Watershed Council on 10 October 2013. http://www.muskokawatershed.org/programs/environmental-lecture-series/the-calcium-story/

[35] The Widespread Threat of Calcium Decline in Fresh Waters. Adam Jeziorski, et al. Science 322, 1374 (2008); DOI: 10.1126/science.1164949

'tree' is removed, that reduces the amount of decaying matter and hence the amount of calcium input into the lake. Since the bark has the largest percentage of calcium, it may be that changes in harvesting could allow forests to regenerate the amount of calcium in the ground to restore benefits to the trees and the fresh water lakes experiencing decline. Dr. Watmough suggested that as little as 1.1 kg of calcium per ha per year could potentially address the issue but more research is required.[36]

Economics and Development

Although the forestry industry has been in significant decline in the province and in Muskoka, there are efforts to address this. Rejuvenation of this sector is important to the economic health of Muskoka but will require ongoing balanced management to ensure increased harvesting is done responsibly.

A promising aspect of Ontario's bioeconomy is the use of forest biomass to generate energy. Ontario's pulp and paper sector has increased the use of forest biomass for energy. In 2007, 54% of the energy used by Ontario's pulp and paper sector was derived from forest biomass. Ontario Power Generation is also implementing the use of forest biomass to generate electricity in some of its formerly coal-fired generating stations.

The harvesting of forests in Muskoka is not as likely a threat to forest health as the economics of development. Muskoka is experiencing urban growth and sprawl with malls expanding the urban areas. As the economy improves, so does the demand for housing. 'Subdivision' development must be managed by municipal governments to ensure the protection of forest areas for all the reasons given. Muskoka will require closely monitored 'infill' residential plans. The rural areas also require careful management in the development of backlots as the waterfront is becoming fully developed.

According to Henry and Quinby, "development not only swallows land outright, it leads to fragmentation of the remaining forest into smaller and smaller blocks. The presence of 'edge species' increases in small woodlots and interior forest species may disappear altogether over time."[37]

"Current scientific research suggests that no park in North America is large enough to sustain a population of large predators without being connected to other woodland areas." The research indicates the isolated interior forest species would suffer from inbreeding and less resistance and

[36] Timber Harvesting and the Health of our Lakes: The Calcium Story by Dr. Shaun Watmough. Lecture hosted by Muskoka Watershed Council on 10 October 2013. http://www.muskokawatershed.org/programs/environmental-lecture-series/the-calcium-story/
[37] Michael Henry and Peter Quinby, 2010. Ontario's Old Growth Forests. Published by Fitzhenry & Whiteside Ltd. 224 pg.

resiliency. Therefore, development must be managed with foresight to the provision of 'corridors' between large forested areas if there is to be protection of these interior forest species.[38]

'The Land Between' is a relatively intact region in the southern portion of the watersheds showing high connectivity across its length, especially when compared to the highly fragmented nature of southern Ontario. Preliminary analysis shows that habitat diversity (gamma diversity) within 'The Land Between' is amongst the highest found in south and central Ontario, in a large part because of its role as an ecotone. Additionally, large tracts of privately owned and stewarded lands as well as large areas of Crown and protected lands contribute to a basic protected areas network in 'The Land Between'.

CURRENT LEGISLATION

Federal

The Plant Protection Act is implemented by the Canadian Food Inspection Agency (CFIA) and is an Act to prevent the importation, exportation and spread of pests injurious to plants, and to provide for their control and eradication and for the certification of plants and other things. The purpose of this Act is to protect plant life and the agricultural and forestry sectors of the Canadian economy by preventing the importation, exportation and spread of pests and by controlling or eradicating pests in Canada.

When an invasive species is identified, the CFIA reviews the situation and works with local provincial agencies, private foresters, municipalities and landowners to develop a program to control or eradicate the species.

Provincial

In order to protect the essential elements of a healthy forest ecosystem, there must be a public will to support the development limitations which will be required to be imposed by various levels of government.

Current legislation and programs dealing with forest health include Ontario Living Legacy, Management Guidelines for Forestry and Resource Based Tourism, municipal tree cutting by-laws, Forest Management Plans, private stewardship incentives, resource stewardship agreements, Forest Stewardship Council certification and Ontario's Biodiversity Strategy.

[38] Ibid.

Muskoka has been blessed for many years with healthy forests and a vibrant forestry industry until the recent economic downturn. When the demand for wood returns and as Muskoka experiences growth, maintaining healthy forests will require concerted efforts by all levels of government, industry and private landowners. Ontario's Municipal Act incorporates provisions for tree cutting by-laws and several municipalities have established such by-laws, most affecting lands abutting waterways.

Natural areas can be managed and protected through provincial and national parks, Crown land and Crown nature reserves, land trust holdings and conservation easements.

Municipal

Forest areas can also be managed through municipal land use policy and private stewardship, but these tools do not guarantee the same level of long-term protection as the federal and provincial controls. Although these two levels of management can work together to create a mosaic of well-managed ecosystems, it is recommended that, at a minimum, the land area required to maintain a natural areas strategy be incorporated into a parks and land trust strategy.

Several municipalities have passed tree cutting by-laws that relate to the waterfront. The purpose of these by-laws is multifaceted and includes protection of aesthetic shoreline views and natural habitat as well as prevention of shoreline erosion. Protection of shoreline habitat by not altering the shoreline for 20 metres (60 feet) back from the water's edge provides a buffer zone which protects water quality by filtering runoff of pollutants and silt, and prevents wind and erosion damage more effectively.

RECOMMENDATIONS:

To protect the essential elements of a healthy forest ecosystem, Muskoka Watershed Council encourages:

1) **The District Municipality of Muskoka** to develop a natural areas strategy that will maintain the integrity of Muskoka's forested land;
2) **The Province of Ontario and Westwind Forest Stewardship Inc.** to continue implementing sustainable forestry practices and, where possible, retain existing Crown land; and
3) **Municipalities in the Muskoka River Watershed** to develop and implement Good Forestry by-laws including education of landowners on good stewardship.

To support these local and provincial efforts, Muskoka Watershed Council will encourage and support the Province, Area Municipalities, individuals and local organizations to:

1) Develop an Invasive Species Strategy to include both:
   a) Stewardship programs on invasive species; and
   b) Implement strategies to manage Beech bark disease.
2) Develop local programs to address the issue of calcium decline in Muskoka's forests and lakes;
3) Incorporate the Ministry of Natural Resources and Forestry's forthcoming Forest Health document ("How Much (Forest) Disturbance Is Too Much") into policy and program objectives; and
4) Use best available climate change information when advising on – or choosing - species for planting, reforestation or afforestation.

Appendix 'I'
TERRESTRIAL INVASIVE SPECIES

The information in this Appendix is excerpts from the **Ontario Invasive Species Watch** website. For more information go to http://www.invadingspecies.com/invaders.

Invasive Trees and Plants

GARLIC MUSTARD

Alliaria petiolata

Garlic mustard has two distinct life stages over its first two years. In the first year, it grows only a cluster of leaves shaped like a rosette, while a strong root system develops. Plants that survive the winter produce flowers and hundreds of seeds in their second year. Dense stands produce more than 60,000 seeds per square metre. Stands of garlic mustard can double in size every four years.

Garlic mustard seeds are easily spread by people and animals. They can remain in the soil for up to 30 years and still be able to sprout. The plant can grow in a wide range of sunny and fully shaded habitats, including undisturbed forest, forest edges, riverbanks and roadsides. Garlic mustard does not provide a valuable food source for native wildlife.

Range

Garlic mustard is established in southern and eastern Ontario as far north as Sault Ste. Marie, in parts of Quebec, and south to North Carolina and Kentucky in the United States. Isolated populations have been found in British Columbia, Nova Scotia, Prince Edward Island and New Brunswick.

Impacts of Garlic Mustard

- Garlic mustard can invade relatively undisturbed forests. Once established it can displace native wildflowers like trilliums (*Trillium spp.*) and Trout lily (*Erythronium americanum*). It hinders other plants by interfering with the growth of fungi that bring nutrients to the roots of the plants.
- The plant threatens several of Ontario's species at risk, including American ginseng (*Panax quinquefolius*), Drooping trillium (*Trillium flexipes*), False rue-anemone (*Enemion*

biternatum), Hoary mountain mint (*Pycnanthemum incanum*), White wood aster (*Eurybia divaricata*), Wild hyacinth (*Camassia scilloides*) and Wood poppy (*Stylophorum diphyllum*).

How to Identify Garlic Mustard

- Young leaves release a strong garlic odour when crushed.
- First-year plants produce a rosette of dark green, kidney-shaped leaves with scalloped edges.
- Second-year plants grow a stem 0.3 to 1.2 metres high with triangular, alternate, sharply toothed leaves.
- Lower leaves are broad, kidney-shaped and up to 10 centimetres across. Upper leaves are triangular and five to 10 centimetres across, narrowing towards the tip.
- Second-year plants produce white flowers with four small petals in May.
- Narrow seed pods 2.5 to six centimetres long split open in mid-summer to reveal tiny black seeds.

Garlic mustard resembles several native Ontario plants. The leaves at the base of the plant look like those of several plants in the carrot family (*Thaspium* and *Zizia*), the daisy family (*Senecio*) and the violet family (*Viola*). The seed pods look like those of several other mustard (*Brassicaceae*) species. The easiest way to distinguish garlic mustard from these plant families is to crush the leaves. If they emit a strong garlic smell, then the plant is most likely Garlic mustard.

DOG-STRANGLING VINE

Vincetoxicum rossicum

The name "dog-strangling vine" refers to two invasive plants native to Eurasia– black swallowwort and pale swallowwort. These look-alike members of the milkweed family were introduced to the northeastern United States in the mid-1800s for use in gardens. In recent years these perennial vines have spread rapidly throughout central and southern Ontario. Because they are so similar, both species have the same common name.

Dog-strangling vine prefers open sunny areas, but can grow well in light shade. It grows aggressively up to two metres high by wrapping itself around trees and other plants, or trailing

along the ground. Dense patches of the vine can "strangle" plants and small trees. It particularly threatens our pines.

The plant can produce up to 28,000 seeds per square metre. The seeds are easily spread by the wind, and new plants can grow from root fragments, making it difficult to destroy. The vine has invaded ravines, hillsides, fence lines, stream banks, roadsides and utility corridors. Dog-strangling vine is also found in prairies, alvars (limestone plains), plantations of pine trees and natural forests.

Range

Dog-strangling vine was first found in Ontario in the late 1800s. Outside its native range, Dog-strangling vine is now found in parts of Ontario, southern Quebec and several American states.

Impacts of Dog-strangling Vine

- Dog-strangling vine forms dense stands that overwhelm and crowd out native plants and young trees, preventing forest regeneration.
- Colonies form mats of interwoven vines that are difficult to walk through and interfere with forest management and recreational activities.
- Leaves and roots may be toxic to livestock. Deer and other browsing animals also avoid Dog-strangling vine, which can increase grazing pressure on more palatable native plants.
- The vine threatens the Monarch butterfly, a species at risk in Ontario. The butterflies lay their eggs on the plant, but the larvae are unable to complete their life cycle and do not survive.

How to Identify Dog-strangling Vine

- Grows one to two metres high by twining onto plants, trees or other structures.
- Leaves are oval with a pointed tip, seven to 12 centimetres long, and grow on opposite sides of the stem.
- Pink to dark purple star-shaped flowers have five petals about five to nine millimetres long.
- The plant produces bean-shaped seed pods four to seven centimetres long that open to release feathery white seeds in late summer.

COMMON BUCKTHORN

Rhamnus cathartica

Common buckthorn (also known as European buckthorn) is a small shrub or tree native to Eurasia. It was introduced to North America in the 1880s as an ornamental shrub and was widely planted for fencerows and windbreaks in agricultural fields. Since then it has spread aggressively throughout southern Ontario and in other provinces.

Common buckthorn can thrive in a wide range of soil and light conditions, enabling it to invade a variety of habitats. It is most often found in woodlands and open fields, where it forms dense stands under which few other plants can grow. Buckthorn can spread widely with the help of birds and animals that eat its fruit, carry the seeds long distances and deposit them in their droppings. Stands of buckthorn can invade roadsides, riverbanks, mature forests, farm fields and hydro corridors.

Range

Outside its native range, Common buckthorn is found in Canada as far west as Saskatchewan and as far east as Nova Scotia. It also grows throughout the northeastern and north central United States.

Impacts of Common Buckthorn

- Buckthorn thrives in a variety of habitats and forms dense thickets that crowd and shade out native plants. It can alter nitrogen levels in the soil, creating better conditions for its own growth and discouraging the growth of native species.
- It produces large numbers of seeds that germinate quickly and prevent the natural growth of native trees and shrubs.
- The shrub can host oat rust, a fungus that causes leaf and crown rust and affects the yield and quality of oats.
- The soybean aphid, an insect that damages soybean crops, can use buckthorn as a host plant to survive the winter. Because it can affect agricultural crops, Common buckthorn is listed as a noxious weed under Ontario's Weed Control Act.

How to Identify Common Buckthorn

- Buckthorn is usually the first shrub to leaf out in the spring and the last to drop its leaves late in the fall.

- It often grows two to three metres tall. Occasionally it reaches six metres, with a trunk up to 25 centimetres in diameter.
- Smooth, dark green leaves are finely toothed, 2.5 to six centimetres long, and arranged in opposing pairs along the stem.
- Most branches older than one year end in a short, sharp thorn.
- Flowers have two to six small yellowish-to-green petals.
- Common buckthorn produces clusters of berry-like black fruit in late summer and fall.

Common buckthorn resembles another invasive species, glossy buckthorn (*Frangula alnus*) and a much smaller native shrub, alder-leafed buckthorn *(Rhamnus alnifolia)*.

Check the chart below to identify common buckthorn, glossy buckthorn and alder-leaved buckthorn.

Common buckthorn (invasive) (*Rhamnus cathartica*)	**Glossy buckthorn (invasive)** *(Frangula alnus)*	**Alder-leaved buckthorn (native)** *(Rhamnus alnifolia)*
		
Grows in drier areas	Grows in wet areas	Grows in very wet areas
Often two to three metres tall; can reach six metres	Often two to three metres tall; can reach six metres	Up to one metre tall
Twigs end in a sharp thorn	No sharp thorn on end of twig	No sharp thorn on end of twig
Usually opposite leaves with finely toothed edges	Alternate, shiny leaves with smooth, wavy edges	Alternate, shiny leaves with toothed edges
		Small growths (stipules) at base of leaves

NORWAY MAPLE

Acer platanoides

Although it is called "Norway" maple, it is actually indigenous to much of Eastern Europe and down to the Caucasus. The species Latin name, meaning "like Platanus," indicates the similarity of the leaves to those of Sycamore and Plane tree, to which it is not related.

How to Identify Norway Maple

Norway maple is a fast-growing maple up to 30 metres (100 feet) tall. It has been widely planted as a street and shade tree due to its vigorous growth and tolerance of poor soil, compaction and pollution.

At first glance it looks similar to a Sugar maple (*Acer saccharum*), but the leaves are usually wider than they are long, and have more lobes than the Sugar maple. Fortunately there is an easy way to identify the Norway maple: Break off a leaf and look for the characteristic white sap which comes out of the leaf stalk.

Photos: John Oyston

Impacts of Norway Maple

The Norway maple produces large numbers of seeds, which are typical maple keys, but with the two wings at almost 180 degrees to each other. These seeds mature in September and are spread by the wind. They can germinate even in dense shade, and the seedlings grow quickly.

Norway maples can out-compete other native trees. They leaf out earlier, and the leaves remain longer into the fall. They tolerate shade themselves, but create deep shade underneath where little else can grow. They suck up water, so that the soil underneath becomes dry. They may also be allelopathic, producing chemicals which prevent native plants from germinating. This sets the scene for soil erosion. A typical comment is that the tree looks healthy, but the ground underneath is a mess and needs work. However, it is almost impossible to grow anything in the shade of a Norway maple.

How to Manage Norway Maple

Smaller seedlings can be removed by hand, and saplings can be dug up. Larger trees may need to be felled by professionals. If girdling or cutting are used the tree must be treated to prevent resprouting. Removing a mature tree to prevent it being a seed source for nearby natural areas is desirable, but can be a major and expensive undertaking. In some cases all that may be possible is to remove some of the lower branches to allow more light through and to reduce seed production.

University of Michigan reports that "the Norway maple will continue to invade forests across the United States unless the spread is controlled. Because seedlings can survive in deep shade for decades, any attempt to eliminate the Norway maple would have to be carefully monitored for over 100 years."

"If nothing is done regarding the invasion of the Norway maple we predict that in years to come there will be strong homogenizing of the Maples. In extreme cases, this would lead to much more plant extinctions, and losses of compatible habitats for animals."

Invasive Diseases

BEECH BARK DISEASE

Nectina coccinea var, faginata

Beech bark disease is a new threat affecting beech (*Fagus grandifolia*) trees in Canada's hardwood and mixed forests. This disease is caused by a combination of an introduced beech scale insect (*Cryptococcus fagisuga*) from Europe, coupled with a nectria fungus. While the nectria fungus was likely native to North America, the introduced scale insect provides an opening to a new host tree for the fungus. The disease begins with many scales feeding on beech tree sap while they form a covering of white wooly wax over their body. Once the scales have opened wounds in the bark, the nectria fungus begins to colonize the bark, cambial layer, and sapwood of the tree. This stage of the disease produces cankers sometimes resulting in isolated tarry spots oozing from the bark and/or raised blisters and calluses on the outer bark covering much of the trunk.

Beech bark disease results in severe die-back in mature beech trees, potentially creating a significant threat to wildlife, biodiversity, and sustainable forestry in Ontario. While this new

disease poses a significant threat to Ontario's majestic beech stands, not all beech are killed by the disease, and prevention on individual beech trees is possible.

Range

After introduction of the beech scale insect to Nova Scotia in 1890, the nectria fungus began infecting wounds opened up by the insect. Beech bark disease is marching from east to west through the Maritimes, Quebec, and throughout the northeastern United States including New York, Pennsylvania, Ohio, and Michigan. Recently, the disease has been identified in Muskoka.

Impacts of Beech Bark Disease

- Attacks mature trees over 8 inches in diameter, rather than small, more vigorous stems.
- Decreases the amount of forage trees for wildlife. Beechnuts are an important food source for wildlife, especially black bears.
- Severely weakens trees, exposing them to other stresses.
- Reduces the marketability or use in wood products.
- Predicted to kill 90% of beech trees.

How to identify Beech Bark Disease

- Mature beech scales are a soft bodied, wingless insect, 0.5 – 1.0 mm long.
- After feeding on the sap under the smooth beech bark, the scale is easily recognized by the covering of white woolly wax on their outer body.
- In fall, the fungal fruiting bodies can be seen as deep-red, lemon-shaped structures in the bark.
- Infection by the nectria fungus may also result in oozing from the bark.
- Tree crowns appear yellow and die back.

What You Can Do

- Learn how to properly identify the signs and symptoms of Beech bark disease.
- Individual high-value ornamental beech trees can be controlled with commercially available products.
- Look for large, healthy individuals with no signs of disease within areas of high infection. These mature trees may be immune to the disease and can provide an excellent seed source for the next generation of Beech bark disease resistant trees.
- Report all sightings to the Invading Species Hotline at 1-800-563-7711.

BUTTERNUT CANKER

Ophiognomonia clavigignenti-juglandacearum

Butternut canker is a fungus that infects and kills healthy butternut trees (*Juglans cinerea*) of any size or age. It is not known where the disease originated, but scientists believe it spread from Asia to North America. The effects of butternut canker were first noticed in the late 1960s.

The fungus usually kills trees quickly. Diseased areas called "cankers" develop under the bark and eventually surround the branches and main stem. The cankers restrict the flow of water and nutrients and "strangle" the tree. Fungal spores can be spread by splashing raindrops, by insects and birds, and by infected seeds, making the fungus hard to control.

Butternut canker kills most trees it infects. However, some trees have few symptoms and live much longer than most. Researchers believe these trees may be genetically resistant to butternut canker, or some environments may increase a tree's tolerance to the disease. These standing trees need to be retained to support the recovery of the species. They provide researchers with valuable genetic information about butternut, as well as seeds for planting and twigs for grafting.

Range

In Canada, the butternut tree is found in southern Ontario, south west Quebec and New Brunswick. Butternut canker has been reported throughout the entire native range of butternut in Canada and the United States. In some areas of the United States it has killed up to 90 per cent of the butternut population.

Impacts of Butternut Canker

- It infects and kills healthy butternut trees.
- Loss of a diseased tree's crown and vigor reduces the number and quality of seeds it produces.
- The butternut tree is now at risk in much of eastern North America. It is listed as an endangered species in Ontario under the Endangered Species Act and in Canada under the Species at Risk Act.
- The commercial value of butternut can be decreased by the surface discoloration of the wood caused by the fungus.

How to Identify Butternut Canker

- Branches in the tree's crown are dying or leafless.
- Dark, sunken, elongated cankers are found on branches and stems, often with a dark, sooty patch of bark.
- During the spring, black fluid oozes from the cracks in the bark. During summer, fall and winter the black fluid dries, leaving a sooty stain.
- Small, stress-induced branches (called epicormic branches) usually grow from the trunk below the dead or infected area.
- Bark may be loose or missing over older cankers.

Invasive Insects

ASIAN LONG-HORNED BEETLE

Anoplophora glabripennis

Asian long-horned beetle (ALHB) is an invasive forest pest with no natural enemies in North America that attacks nearly all broadleaf trees, with native Maples being the preferred host. It was introduced to North America in the 1990's through untreated wooden shipping pallets. Adults lay their eggs in hardwood trees, and larvae then tunnel through the living tissue of the tree stopping the flow of water and nutrients, killing it. There have been very few sightings of ALHB in Ontario and it is important to be on the lookout for this dangerous invader. Several native non-harmful beetles can be easily confused with ALHB, so take a close look at how to identify this beetle listed below.

Range

Asian long-horned beetle is native to China and Korea where it is considered a major pest causing mortality of elm, maple, poplar and willow trees. Since arriving in the US, populations have been confirmed in New York, Illinois, New Jersey, and Ohio. In Canada, ALHB was confirmed in an industrial park in the Toronto area in September 2003. By November 2003 susceptible host trees were being removed from the area to eliminate possible ALHB habitat. Currently, ALHB has not been found anywhere in Ontario since 2007, indicating that early detection and rapid response have been effective.

Impacts of Asian Long-horned Beetle

- Insecticides do not protect trees; trees must be cut down and burned or chipped.
- It is easily transported in firewood, live trees or untreated lumber.
- Potential decline in hardwood (broadleaf) trees, particularly maple, could have major consequences for Ontario's wildlife and biodiversity, negatively affecting future generations.

How to Identify Asian Long-horned Beetle

- Adults are 2 – 4 cm (¾ – 1½ inches) in length.
- Shiny black with prominent, irregular white spots.
- Distinct bluish-white legs.
- Long, black and white banded antennae, one to two times its body length.
- Adults leave a round exit hole, approximately 1 cm across (slightly smaller than a dime) in trees.

MOUNTAIN PINE BEETLE

Dendroctonus ponderosae

Mountain pine beetle is an insect responsible for creating widespread pine mortality in British Columbia. Native to western North American forests, this small beetle has reduced the growth of millions of trees and caused widespread mortality to commercial tree species. In the most recent infestation, estimated mortality from Mountain pine beetle has reached into the hundreds of millions of trees and covers an area roughly five times the size of Vancouver Island.

Mountain pine beetle adults will tunnel into a tree where they lay their eggs. The small beetles will mass together and attack a tree as one coordinated force, overcoming the tree's defenses and ability to "pitch out" the attacking beetles. Beetle larvae will then spend the winter feeding under the bark where they feed on the tree's circulatory system. Between July and September, adult beetles emerge from the bark and fly in search of a new host tree.

Range

The home range of the Mountain pine beetle follows the west coast of North America from British Columbia and western Alberta to northern Mexico. The most extensive outbreaks have been in southern British Columbia and in the northern Rocky Mountains. Currently there are no populations in Ontario, however reports have predicted that climate change may allow the beetles to spread north and east.

Impacts of Mountain Pine Beetle

- Widespread mortality of Lodgepole pine (*Pinus contorta*) and commercial tree species such as Sugar pine (*Pinus lambertiana*), Western white pine (*Pinus monticola*) and Ponderosa pine (*Pinus ponderosa*).
- Increased risk of large fires with dead and dying trees creating a landscape of highly flammable stems.
- Loss of wildlife habitat.
- Degrades the overall visual quality of forests.

How to Identify Mountain Pine Beetle

- Adult beetles are about 5 mm long and begin as a light creamy tan color, turning black when they mature.
- Infected trees have red needles at the crown.
- Sawdust collects at the base of infected trees from larvae feeding.
- Larvae are legless grubs with red-brown heads and are found under the bark.
- Beetles transfer a fungus to the tree that stains the sapwood blue.

EMERALD ASH BORER

Argrilus planipennis

Emerald ash borer is a forest pest native to Asia that has killed millions of ash trees in southwestern Ontario and the Great Lakes States. Due to its major economic and environmental threat, the Canadian Food Inspection Agency has prohibited the movement of firewood and any material made from ash trees outside of designated areas under an Infested Places Order.

The Emerald ash borer attacks both healthy and stressed ash trees when its larvae tunnel through the tree's vascular system, which delivers water, nutrients and sugars throughout the tree. Emerald ash borer will only travel a few kilometers per year on its own; however it can be easily dispersed long distances by people moving infested materials, such as firewood, logs, lumber, and woodchips.

Range

The Emerald ash borer was first discovered in North America in 2002. It is thought to have been shipped to Canada in untreated wooden packaging materials. The range of Emerald ash borer in Ontario is rapidly expanding through the movement of infested materials. For an up-to-date range map, consult with the Canadian Food Inspection Agency.

Impacts of Emerald Ash Borer

- Attacks both stressed and healthy ash trees.
- No known natural enemies to control the population or spread.
- Once infested, mortality of ash trees is nearly 100%.
- Loss of habitat and food for other species.
- Extremely harmful to urban and rural biodiversity.
- Loss of valuable timber that is used for furniture, building and recreational products.

How to Identify Emerald Ash Borer

- Trees appear to be thinning at the crown, dead branches and yellowing of leaves.
- Adults emerge from a D-shaped exit hole between mid-May and late June.
- Adults are metallic blue-green.
- Bodies are narrow and 8.5 to 14 mm long.
- Larvae are a creamy white colour with a light brown head.

What You Can Do to Aid the Control of Invasive Pests

- Learn how to identify invasive pests and what infested trees look like, as well as which host trees they target.
- Don't move firewood or other potentially infested wood material over long distances. With firewood, remember: burn it where you buy it!
- Report sightings to the toll-free Invading Species Hotline at 1-800-563-7711.

HEMLOCK WOOLLY ADELGID

Adelges tsugae

Hemlock woolly adelgid (*Adelges tsugae*), or HWA, is an invasive insect that is a serious pest, damaging and killing eastern North American hemlock species. It has been found in isolated locations in Ontario since 2012, but is not yet known to be established in eastern Canada.

Hemlock woolly adelgid is native to Asia, where it is not a significant pest. It was first reported in British Columbia in the 1920's but is a minor pest of western hemlock. First detected in the east in the 1950's, HWA is a threat to Eastern hemlock. The adelgid has no natural enemies in eastern North America and since it is difficult to detect, especially at low population levels, it can easily become established.

How to Identify Hemlock Woolly Adelgid

On infested trees, white woolly patches are seen on the underside of twigs near the base of the needles. They are easiest so see in late winter or spring (March to May in southern Ontario). Examine the tree by standing with your back to the bole and looking upward at the underside of the branches (rather than checking the tree from the side or the top). Carefully inspect the underside of the lowest branches, especially the younger twigs. The adelgid is difficult to detect at early stages of the infestation when there are few insects, and may be located in the upper branches of the tree. At later stages of infestation you will also see dieback of foliage and twigs. Distribution of HWA infested trees can be patchy within a stand - start by looking at hemlock trees along streams where they are often transported by birds.

What You Can Do To Manage Hemlock Woolly Adelgid

This insect is manageable in the landscape and nursery if found early and treated. Forest trees pose a different challenge and thus are almost impossible to treat effectively or economically. Many of those may be lost in time. The best overall strategy is to be aware of its signs and to monitor for it on a regular basis. Once found, there are a couple of options.

- Horticultural oil sprays work extremely well when and where they can be properly utilized. It is important to thoroughly apply the oil throughout the tree. Homeowners can treat their own hemlock shrubs and hedges with this product. Large trees will need to be sprayed by a professional arborist with the proper spray application equipment. A dormant oil spray can be applied while the plant is dormant and the correct weather conditions prevail, generally late March into April. Dormant oils must be applied before the buds open and when there will not be freezing temperatures for 24 to 48 hours after

application in order to reduce injury to the plants. Do not spray on cold days. Temperatures of at least 7 °C are recommended. However, avoid overcast or wet days, which greatly slows the drying time of the oil.

- Horticultural oils can also be applied at the "summer" rate during much of the growing season. Again, avoid cool, overcast days or hot and humid days. Oil sprays are used for established populations of the HWA but offer no preventative benefits if the adelgid isn't present. Hemlocks infested with the HWA should be treated with oil sprays both at the beginning of the growing season and then once again towards the end of summer to insure proper control. Smaller hemlocks (shrubs) may only require one application. Once under control, continue to monitor for future re-infestations and then treat once found.
- The best strategy is to be acutely aware of this pest, its signs and damage, and to monitor for it regularly. Once found, it needs to be treated. The HWA is very manageable but hemlocks need to be thought of as high maintenance plants in those areas where the adelgid already exists. The worst thing to do is to not deal with it when it arrives. Such populations will only lead to the demise of the tree and act as a reservoir for the pest for your neighbor's trees. Also, hemlock tends to be a rather shallow-rooted tree and prone to drought stress which can exacerbate the problem with HWA. Be sure to water hemlocks deeply (1 inch of water once a week) during times of high temperatures and limited rainfall.

GYPSY MOTH

Lymantria dispar

The Gypsy moth is an insect native to Europe and Asia that has been severely weakening trees across North America. The Gypsy moth was introduced to North America in the late 1860s near Boston and has spread over the past century. Despite the successful use of insect predators, as well as fungal and viral controls, gypsy moth populations do occasionally reach outbreak levels and continue to expand their range.

Gypsy moth caterpillars defoliate host trees, mostly hardwood species such as oak, birch, poplar, willow and maple. During outbreak years, nearly all broadleaf trees may be completely defoliated, caterpillars appear everywhere, and "frass" (caterpillar droppings) appear to rain from the trees. Adult Gypsy moths are only seen in mid-summer when temperatures are above freezing. This species is known to infest trees in woodland or suburban areas.

Range

Gypsy moths can be found throughout southern Canada, across the eastern and central United States, and most of the western states. Populations have been found in southern Ontario, New Brunswick, Nova Scotia and British Columbia. Each population varies annually and fluctuates with local conditions.

Impacts of Gypsy Moth

- Defoliates and kills large amounts of trees, affecting the many benefits provided by trees.
- Economic impacts affect all forest users.
- Caterpillars may chew small holes in leaves or completely strip a canopy, depending on age and population levels.

How to Identify Gypsy Moth

- Four development stages: egg, caterpillar, pupa and moth.
- Caterpillars are 5-6 cm long with five pairs of blue dots and six pairs of bright red dots along their back.
- Female moths are white with dark markings and cannot fly.
- Male moths are brown and can fly.
- Females are larger than males with a 5 cm wing span, males only span 2.5 cm.
- Egg masses are about 4 cm long, tan colored, and can be found on tree trunks, furniture, buildings, etc.

What You Can Do To Control Gypsy Moth

- Learn how to identify the Gypsy moth during its various life stages.
- Egg masses can be easily controlled by removing and burning or soaking with a soap and water mixture.
- A band of either burlap or other cloth product wrapped around the trunk will provide a place for caterpillars to hide during the heat of the day. Check these bands regularly and scrape caterpillars into a container of soapy water.