BEST MANAGEMENT PRACTICES
Agroforestry Series Volume 1

Woodlot Management

Canada

Ontario

Ontario Stewardship

Eastern Ontario Model Forest

What is a Best Management Practice or "BMP"?

▶ a proven, practical and affordable approach to conserving soil, water and other natural resources in rural areas

Who decides what qualifies as a BMP?

▶ a team that represents many facets of agriculture and rural land ownership in Ontario, including farmers, researchers, natural resource managers, regulatory agency staff, extension staff and agribusiness professionals

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▶ innovative, award-winning books presenting many options that can be tailored to meet your particular environmental concern and circumstances

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Pesticide Storage, Handling and Application
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How do I obtain a BMP book?

▶ Online at www.publications.serviceontario.ca

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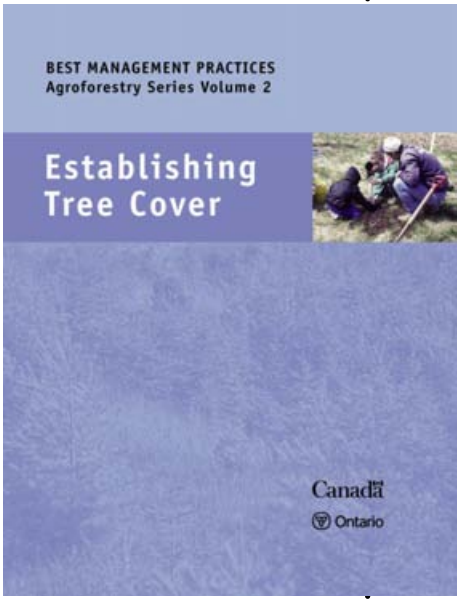
FOREWORD

This book is Volume 1 of a two-volume set on agroforestry.

- Volume 1, *Woodlot Management,* addresses the management of existing woodlots, including established plantations.
- Volume 2, *Establishing Tree Cover,* addresses the planning and establishment of agroforestry plantings. This title will explore the following types of plantings:
  - afforestation (plantings in fields)
  - windbreaks and shelterbelts
  - treed buffer strips
  - intercropping
  - silvipasture.

Printing of Volume 2 is planned for 2008.



Related titles in the Best Management Practices series, especially *Fish and Wildlife Habitat Management* and *Buffer Strips,* may be helpful to you. Instructions for getting copies of these titles are on the previous page.

The general agroforestry principles described in this book are mainly applicable to areas south of the Canadian Shield.

Words that appear in the glossary on page 143 are italicized at first mention.

Thank you, and we hope you find this book helpful in making the most of your woodlot.

METRIC–IMPERIAL CONVERSION FACTORS

Convert		To		Metric
%	►	kg/1000 L	multiply by	10
%	►	kg/tonne	multiply by	10
mg/L	►	%	divide by	10,000

Convert		To		Imperial
%	►	lbs per 1000 gallons	multiply by	100
%	►	lbs per ton	multiply by	20
ppm	►	%	divide by	10,000

Note: 1 m^3 = 1000 L

UNITS OF MEASURE

While Canada "went metric" over 30 years ago, many commonly used measurements such as land area are still expressed using imperial units. Acres of land are a good example: landowners seldom, if ever, refer to the size of their property in hectares. For your convenience, most of the measurements used in this manual are provided in both metric and imperial units. However, where common usage, common sense, space limitations or regulatory concerns dictate, one or the other may appear exclusively.

CONVERSION FROM...	FACTOR	EXAMPLE
METRES TO FEET	1 metre = 3.281 feet	A 20.6-m tall tree is 67.6 ft (20.6 x 3.281)
FEET TO METRES	1 foot = .3048	A 100-ft buffer is 30.48 m (100 x .3048)
ACRES TO HECTARES	1 acre = .405 ha	A 35-acre field is 14.16 ha
HECTARES TO ACRES	1 ha = 2.47 ac	A 1.4-ha plot is 3.5 ac

CONVERSIONS – METRIC AND IMPERIAL

Common Conversions

1 gallon	=	4.546 litres	1 acre	=	0.405 hectare
1 gallon	=	1.201 US gallons	1 acre	=	43,560 $feet^2$
1 gallon	=	0.161 ft^3	1 lb/ac	=	1.12 kilogram/hectare
1 US gallon	=	3.785 litres	1 ton/ac	=	2.25 tonnes/hectare
1 US gallon	=	0.833 Imp gallon	1 gal/ac	=	11.2 litre/hectare
1 ton	=	0.907 tonne	1000 gal/ac	=	11200 litre/hectare
1 pound	=	0.454 kilogram	1000 gal/ac	=	11.2 $metre^3$/hectare
1 tonne	=	2205 pounds	1 metre	=	3.28 feet
1 $foot^3$	=	6.229 gallons	1 metre	=	39.4 inches

Application Rate Conversions

Metric to Imperial (Approximate)			Imperial to Metric (Approximate)		
Litres per hectare x 0.09	=	gallons per acre	Gallons per acre x 11.23	=	litres per hectare (L/ha)
Litres per hectare x 0.36	=	quarts per acre	Quarts per acre x 2.8	=	litres per hectare (L/ha)
Litres per hectare x 0.71	=	pints per acre	Pints per acre x 1.4	=	litres per hectare (L/ha)
Millilitres per hectare x 0.015	=	fluid ounces per acre	Fluid ounces per acre x 70	=	millilitres per hectare (mL/ha)
Grams per hectare x 0.015	=	ounces per acre	Tons per acre x 2.24	=	tonnes per hectare (t/ha)
Kilograms per hectare x 0.89	=	pounds per acre	Pounds per acre x 1.12	=	kilograms per hectare (kg/ha)
Tonnes per hectare x 0.45	=	tons per acre	Ounces per acre x 70	=	grams per hectare (g/ha)
Kilograms per 1000 L x 10	=	lbs per 1000 gallons	Pounds per ton x .5	=	kilograms per tonne (kg/t)

CONTENTS

INTRODUCTION

FARMING AND FORESTRY

Forests have been used by farmers since the early days of settlement.

Forest crops have been used by farmers since the first days of settlement. Even before all of their land was cleared, many settlers were producing their own maple sugar. Trees provided logs and lumber for homes and farm buildings, fence rails to contain livestock, and an ample supply of fuelwood to fend off winter's cold.

Since settlement, farmers' attention has been focused primarily on the business of food production – in the fields and in the barns. Woodlots have been more peripheral, except perhaps as a source of firewood.

But in recent years, the worlds of farming and forestry have become reacquainted. As margins in food production grow ever tighter, many farmers are looking to reduce their own costs and diversify their sources of income.

At the same time, they recognize that the value of a woodlot is not only measured in dollar signs. Air, water and soil quality, wildlife habitat, and aesthetic and recreation opportunities are all beneficiaries of a well-managed woodlot. Agroforestry may serve as an effective alternative to more conventional land use practices, particularly on sensitive soils and marginal agricultural lands.

In agroforestry, trees, shrubs and small woodlots are counted as part of a farming system that promotes sustainability.

Which brings us to the topic of this book. Woodlots obviously differ from field crops. There is a learning curve in terms of knowing what you have, and what, when and how much to harvest, and how to attain long-term sustainability and environmental enrichment.

The good news is that agroforestry integrates the land use practices of agriculture, animal husbandry, and forestry within a given landscape or farm. It produces while conserving resources of the land on which that production depends. This book will show you how, by:

- ▸ explaining the principles of farm woodland management
- ▸ describing best management practices for woodlots and plantations
- ▸ highlighting new opportunities
- ▸ providing links to key contacts and more information.

For each woodland type and endeavour, the costs and benefits of each best management practice will be laid out to help you choose the best option for you. The impacts on soil, water, air, and habitat will also be presented.

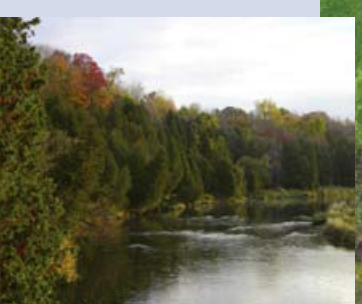
If agroforestry is fairly new to you, you may find some new terminology. *Italicized* words are defined in the glossary on page 143.

THE ENVIRONMENTAL FARM PLAN DEFINES AGROFORESTRY THIS WAY:

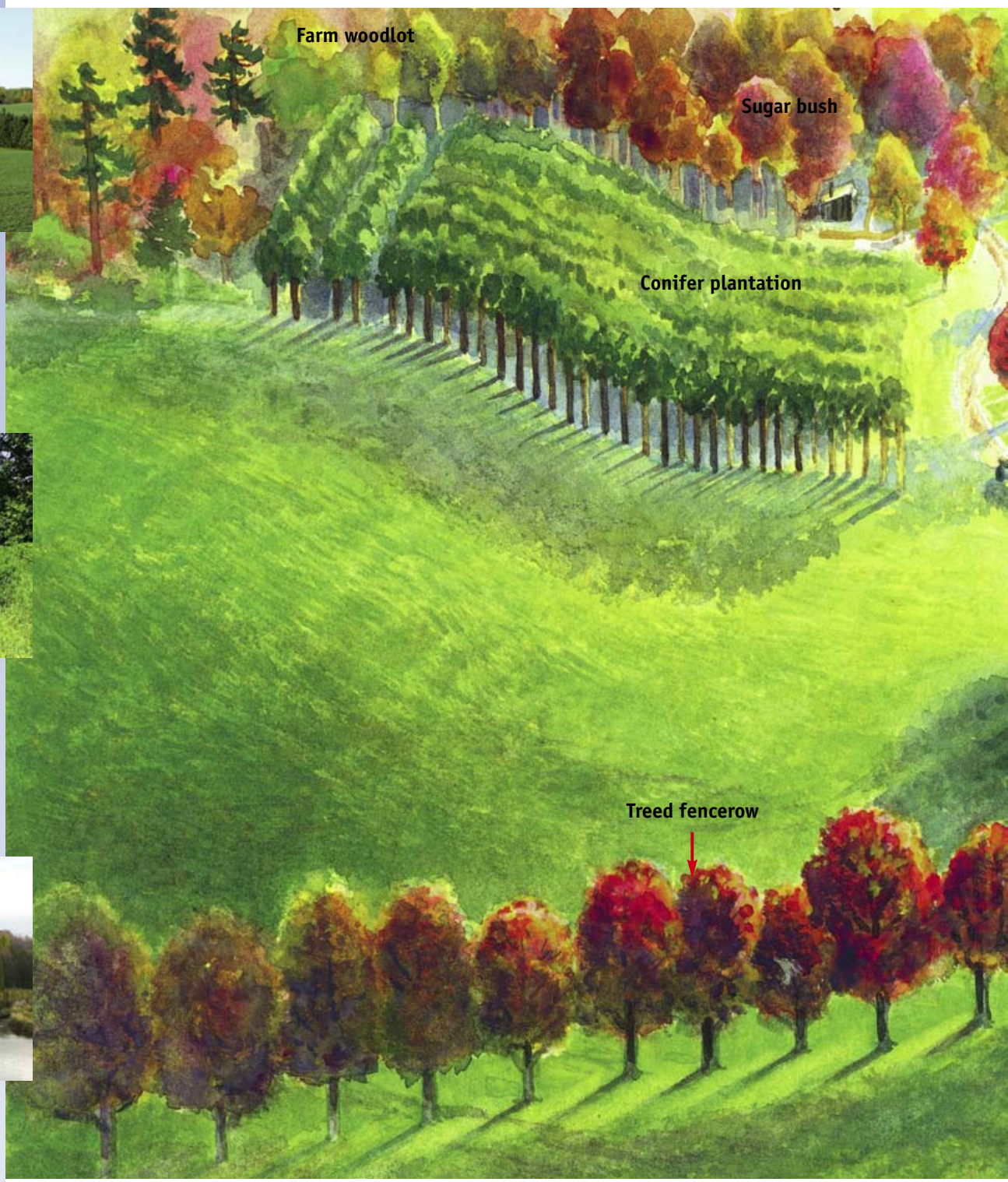
Farm forestry (agronomy and forestry): Practices that bring trees into farm operations and allow for the production of crops, livestock, and trees while obtaining extra benefits from the land. These practices include woodlot management, naturalized habitats, *plantations,* windbreaks, and trees on streambanks.

Windbreaks significantly slow wind speed over fields, and in so doing reduce soil erosion.

Treed fencerows serve as natural shelterbelts, travel corridors for wildlife, bird habitat and sources for products such as fuelwood.



Forests found in floodplains and ravines protect riparian areas and, with care, can be managed for valuable wood products.



Agroforestry practices offer Ontario's farmers and rural landowners a range of opportunities, by generating saleable crops and other products for farm use, and by beautifying their property.

To reap the most benefits of your farm woodlot, you need to know what you have, and when, what and how to harvest.

A plantation can provide valuable forest products.

Buffer strips protect water bodies.

BENEFITS

Livestock can benefit from the shade of trees on the farm.

Tree planting can be an enjoyable family activity that provides many long-term benefits on the farm.

Well-planned forestry operations can provide the owner with a continuous supply of fuelwood and timber products.

Much of the value of fencerows, woodlots and trees on the farm is intangible. Most often it is tied to your favourite memories: making maple syrup in the sugar bush, hunting the fencerows for rabbits, grouse and turkey, seeing young fawns in the meadow, or heating the farmstead with wood from the woodlot.

POTENTIAL BENEFITS OF AGROFORESTRY

ECONOMIC	ENVIRONMENTAL
• diversified farm income • energy savings • significant opportunities for generating products for farm use (see next section) • opportunities for farm labour	• decreased water and wind erosion • improved soil quality • increased biodiversity of plants and animals • healthier riparian and other natural areas • sequestration of carbon and reduced effects of greenhouse gases

Plantations can be thinned to generate wood products for sale or farm use.

Managing woodlands can diversify farm income by harvesting and selling high value timber products.

Trees and forests provide much-needed habitat for nesting birds and other wildlife species.

Farm woodlands offer numerous opportunities to diversify farm sales.

Non-wood forest products such as cedar boughs can also be harvested from woodlands.

Riparian forests should be managed to protect water quality and wildlife habitat.

Two key benefits of agroforestry to farmers are the convenience and cost savings enjoyed by having their own woodland and tree crops for use on the farm. The value of these crops and all other agricultural commodities produced on farms and consumed by individuals living on these farm operations is referred to as *income in-kind.*

Many farm fences are made from materials harvested and processed from woodlots owned by the farmer.

Today many woodland owners continue to use forest crops grown on the farm. Statistics for various farm products consistently show that forest products provide the largest income in-kind benefit to farmers of all the commodities produced on the farm. From 1999 to 2003, the average value of forest products used on Ontario farms amounted to 77% of the total value of all products produced and used at home. In 2003 the income in-kind value for forest products was just over $29 million.

CHALLENGES

Agroforestry presents its own set of challenges, including: getting started, potential or perceived conflicts with the production of agricultural products, and the costs. These have all served to slow the wide-scale implementation of agroforestry practices.

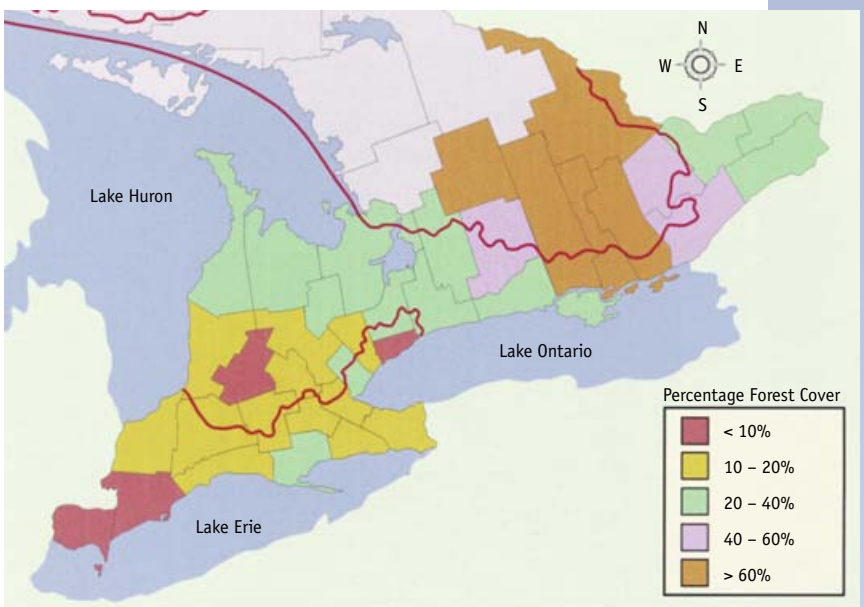
Some see windbreaks as obstacles to field operations and crop yields. In truth, windbreaks improve net yield and protect the soil.

A study was conducted in southwestern Ontario to compare returns on croplands with well-managed woodlands. The results showed an average return of $222.00/ac/yr for a woodlot and a return of $107/ac/yr for field crops. Soil and climate conditions were identical.

BARRIER TO ADOPTING AGROFORESTRY PRACTICES	POTENTIAL
PLANTING TREES WILL REDUCE PRODUCTIVITY ON MY LANDS.	Trees should be planted on lands that will not negatively impact the existing farming operations. See page 100 for help with determining whether to plant trees, and if so, where.
TREES WILL INTERFERE WITH MY OPERATION.	For the most part, trees benefit farm operations. Woodlands and windbreaks will reduce crop performance in the portion of the cropland nearest the trees, but will improve the net yield of protected cropland up to 20%.
TREES ON THE FARM WILL ATTRACT PROBLEM WILDLIFE.	In some areas, wildlife damage to crops can be a problem. Information is available on controlling problem wildlife. Bear in mind that trees can also provide habitat for beneficial wildlife that can help control problem insects and rodents.

AGROFORESTRY'S POTENTIAL IN ONTARIO

With just over one million square kilometres, Ontario offers a diversity of landform and climate that affects not only the distribution of native plant and animal species, but also the type and intensity of agriculture practised within it. This landscape and climatic variability from north to south and east to west also influences the opportunities for agroforestry.



This book focuses on Site Regions 6E and 7E. A site region is an area with relatively uniform climate, soil, plants, animals and other organisms interacting to produce a recurring pattern of forest cover types. For example, Sugar Maple–Beech is a more common cover type of Site Region 6E. In Site Region 7E, Red Oak–Hickory–Ash is a more common cover type.

Ontario has approximately 900,000 hectares (2.23 million acres) of marginal farmland, a portion of which is managed for pasture. Some of this land would be suitable for tree crop production of one kind or another. When you combine this with the over 4.7 million hectares (11.6 million acres) of existing woodlands and plantations, you can appreciate the great opportunity for farmers and rural landowners to participate in agroforestry practices.

Harvesting low-value, low-quality trees for firewood improves growing conditions for remaining trees, including valuable *crop trees*.

Owls, hawks, snakes and foxes will use tree cover to hunt for mice and rats.

Planting trees in the 1930s helped reduce wind erosion in many areas of Ontario. Many of these forests are now owned by municipalities.

UNDERSTANDING FARM WOODLANDS

Just as agricultural yields are affected by field and crop variables, site and species characteristics will have a dramatic impact on the growth and yield of your woodlot. By knowing these characteristics and how they interact to affect tree growth, you can tailor your management activities to help maximize benefits and offset potential problems. This chapter deals with some of these essential characteristics.

We'll begin with a single woodland tree:

- its life cycle
- key features of and stages in its development
- what it requires to grow well in a woodland.

Then we'll step back to look at the woodland as a whole:

- its life cycle
- its function as an ecosystem
- what affects its health
- different types of woodlands.

Whether trees or field crops, plant growth is influenced by a variety of interrelated factors.

THE LIFE CYCLE OF A TREE

As with all plants, trees grow, reproduce and die. Familiarity with an individual tree's life cycle forms a good foundation for understanding how trees and forests grow and change with time, and how best to manage them.

Soft Maple (Red, Silver), Basswood (pictured) and many other hardwoods can regenerate following harvest by stem-sprouts or coppice. New shoots can mature into a clump of trees using the rooting system of the original parent tree. Coppice can be managed as a quick way to regenerate desirable species.

Some trees such as this Poplar variety mature in 25 years or less.

LIFE CYCLE STAGES OF A TREE

INITIATION	GROWTH	MATURITY	DECLINE
• Trees can grow from: ○ seeds, nuts ○ vegetative reproduction ○ coppice – from stumps, e.g., Basswood, most hardwoods ○ root suckering, e.g., Poplar, Beech and Sumac ○ layering – branches rooting and forming new trees, e.g., White Cedar, Black Spruce.	• Once established, a tree will grow rapidly: ○ if growth needs are met (light, water, nutrients) ○ when there's more height and root growth than diameter growth. • Fast-growing trees can quickly dominate surroundings. • Shade-tolerant trees often survive until growth conditions improve.	• Space, light and moisture will affect tree growth in mature stage. • Trees survive best if they reach the upper canopy (overstory). • Potential for diameter growth is greatest in this stage. • Mature trees will produce seed.	• Trees usually begin to decline long before they die. • Stress by insects, disease, weather, human disturbance and inter-tree competition causes trees to lose vigour and their health to decline. • Stress factors make trees more vulnerable to other causes of decline. • With decline comes decay caused by fungal infections, which reduce tree quality and value, but increase habitat potential for wildlife, e.g., for cavity-dwellers.

LIFE CYCLE

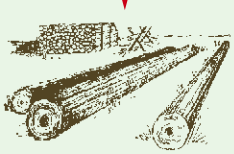
Germinating acorn.

A tree's potential lifespan varies by species. Most trees do not live to their potential.

Mature and declining trees can reproduce.

Almost all of a tree's energy is put into vegetative growth.

Dead and declining trees provide wildlife habitat.

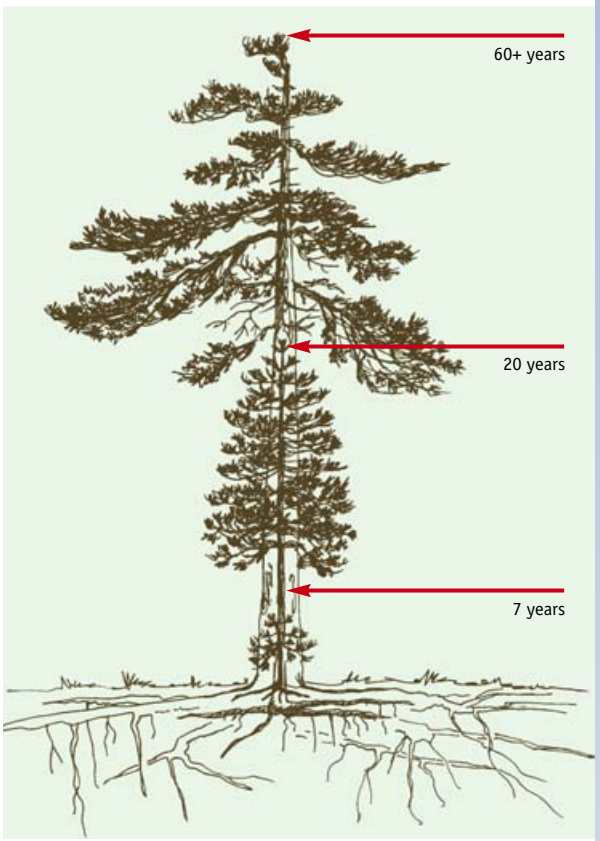


Harvesting can improve forest health by freeing up space for the remaining trees.

TREE GROWTH

Like annual agricultural crops, trees become established and grow. Both convert light energy into chemical energy through photosynthesis. Both use this energy to send down roots and increase green (vegetative) growth.

This is where the similarities end. Unlike annual agricultural crops, trees are perennials and diversify their growth efforts to roots, buds, stems, branches and diameter growth.

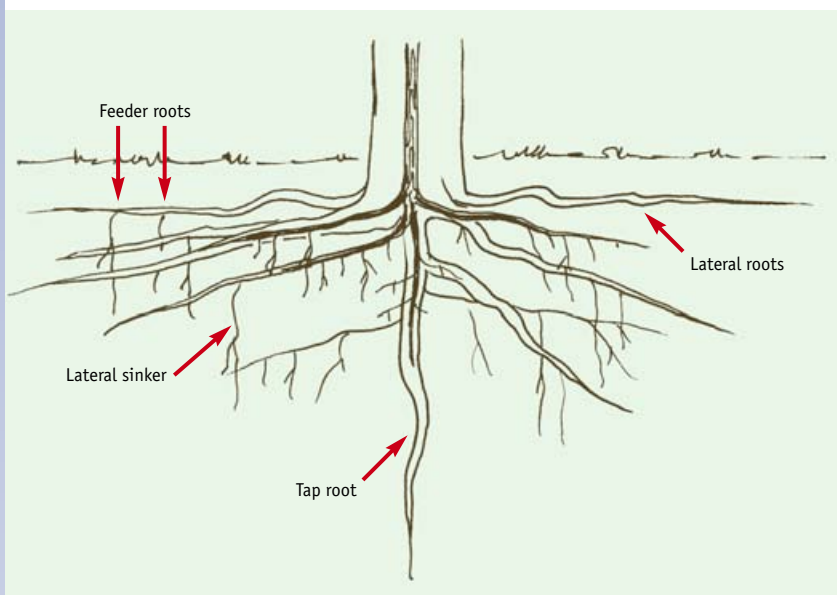


Each year, a tree will grow both above and below the ground. Above-ground growth includes stem height and diameter, leaves and seeds; below-ground growth includes root length and diameter growth. All growth occurs in specialized tissues called meristems, which have the ability to divide and make new cells. Meristem tissues are concentrated at branch and root tips as well as in a thin layer of cells called the *cambium*, which is found just beneath the bark.

HEIGHT GROWTH

Many trees, like this White Spruce, tend to have a *dominant* leader that releases hormones to suppress the growth of lateral branches near it. This is known as apical dominance. Apical dominance is the characteristic that contributes to height growth. Conifers tend to exhibit more apical dominance than hardwoods. This gives their characteristic pyramidal shape. Some hardwoods, like Maple and Oak, will have stronger apical dominance when they are young than when they are mature.

ROOT GROWTH AND DEVELOPMENT



Roots provide two basic functions for the tree. They absorb and transport water and nutrients from the soil, and provide support for the above-ground portion of the tree. Roots will grow wherever environmental conditions are favourable, which in most cases is in the uppermost metre – although the major portion of a tree's root system is in the top few centimetres of soil.

There are two basic types of roots. Woody roots are large lateral roots that form near the base of root and stem. They support and anchor the tree.

Non-woody (feeder) roots are found mostly in the upper few centimetres of the soil and are used for absorption. In some species like Ash, they may have extensions called root hairs to increase the absorptive capacity of the tree. Many roots have mychorrizae (fungi) associated with them.

BUDS AND BRANCHES

Height and branch growth generally begins as soon as a tree comes out of dormancy in the spring. Warmer temperature and longer days trigger bud opening and cell division, and growth in the branch just below the buds. Some buds will grow to form new lateral branches, others into leaves, and still others into flowers.

CROWN DEVELOPMENT

In forest conditions, inter-tree competition forces trees to grow taller, straighter and carry smaller crowns. In open-grown conditions, although the diameter growth is greater, trees tend to branch out, often do not grow straight, and have large crowns.

The best logs are defect-free cylinders of wood. Woodland conditions are significant determinants in log quality.

One of the key goals of intensive forest management for valuable wood products is to manage the space between trees (and as a result, crown size) so as to strike a balance between maximum diameter growth, merchantable height and timber quality.

DIAMETER GROWTH

Diameter growth is directly related to tree spacing and available light. The diameter growth (annual growth rings) of two 70-year-old Red Pine trees is contrasted in this picture. The one on the left shows evidence of tight spacing during establishment (small dark centre at right), and improved spacing (by thinning) and light conditions for most of its life (shown by white wood and large rings).

The tree on the right was subjected to high-density conditions (large dark centre) until the woodlot was thinned. Note how the lighter-coloured growth rings increase in width after the woodlot was thinned.

The *cambium* is a thin layer of living cells between the wood of a tree and its bark. Each year these cells divide and increase the diameter of the trunk and branches by adding a new layer of wood to the tree. Tree diameter growth is greatest when there is adequate space, a well-positioned and well-formed crown, and no site limitations.

TREE GROWTH REQUIREMENTS

Silvics is a word that describes the growth requirements and characteristics of a tree species in terms of its capacity to reproduce, establish, and develop. Silvics also indicates the potential of the species to react and adapt to forest disturbance and timber management activities.

Understanding silvics simplifies the prediction of species' performance to forest management practices. There are four key growth requirements that help to explain why species grow under certain conditions and why they are commonly found together on the same site. These are:

- light
- moisture
- nutrients
- soil/seedbed.

SPECIES LIGHT REQUIREMENTS (SHADE TOLERANCE)

Trees require light for survival, growth and reproduction. Species such as Sugar Maple, Hemlock and Balsam Fir will survive and grow under the shade of existing trees. These trees are tolerant of shade and have adapted to regenerating in the understory of an existing forest.

Shade tolerance refers to a plant's ability to survive and grow in the shade of another tree. Shade tolerance is a major driving force behind forest *succession*.

Shade-tolerant species can survive this way for decades, growing relatively slowly in height and diameter until the existing canopy is opened up. They are often able to capitalize on the increased light levels and grow more vigorously. However, sometimes shade-tolerant trees can lose their ability to respond to improved growing conditions if they have survived under a heavy canopy for an extended period. Other species like Aspen and Birch require full sunlight and will not survive long in the shade.

SHADE-TOLERANT SPECIES (CLIMAX SPECIES)	MID-TOLERANT SPECIES	INTOLERANT SPECIES (PIONEER SPECIES)
Hemlock, Beech, Ironwood, Sugar Maple, Balsam Fir	White Ash, White Spruce, Red Oak, White Oak, White Pine, Basswood, White Elm, Silver Maple, Red Maple	Aspen, Red Pine, Jack Pine, White Birch, Black Locust, Tamarack, Eastern Red Cedar, Black Cherry
CAROLINIAN SPECIES		
American Chestnut, Black Gum, Big Shellbark Hickory, Black Maple, Blue Ash, Ohio Buckeye	Black Oak, Common Hackberry, Cucumber Tree, Blue Ash, Ohio Buckeye, Chinquapin Oak	Common Hop Tree, Dwarf Chinquapin Oak, Dwarf Hackberry, Honey Locust, Kentucky Coffee Tree, Northern Pin Oak

Balsam Fir is a shade-tolerant species that can survive as a sapling in the understory of a forest for decades. If the canopy is opened up through logging or other disturbance, the sapling is ready to capitalize on the increase in light thanks to a well-established root system.

Some tree species display different levels of shade tolerance throughout their life span. The slow-growing Eastern White Cedar requires full sunlight when it's young.

MOISTURE REQUIREMENTS

All plants require moisture for their day-to-day biological functioning, and trees are no exception. A tree draws in water through its roots where it's transported up through the stem and branches, and out to the leaves. In some cases, a tree's root system may extend well beyond its crown – sometimes as far as four to seven times the drip line perimeter of the tree crown as measured on the ground.

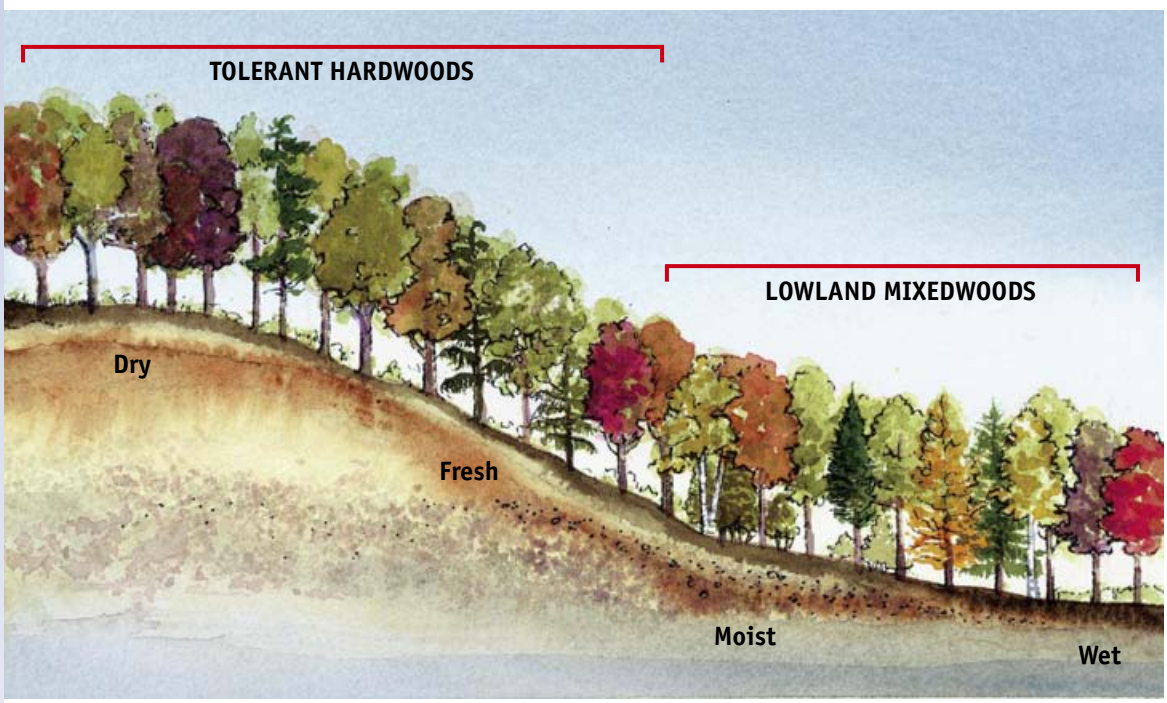
Some of the moisture in the leaf is used for photosynthesis, although the vast majority is lost through the process of evapotranspiration.

The availability of water throughout the growing season is classified using the concept of soil *moisture regime.* There are four moisture regimes. Some species are adapted to only one, while others are adapted to all. The chart below summarizes the most common species by moisture regime. **Bolded** species in this chart refer to species that prefer that moisture regime.

MOISTURE REQUIREMENTS OF SELECTED TREE SPECIES

MOISTURE REGIME	DESCRIPTION	COMMON SPECIES
1. DRY	• soil drains rapidly • no standing water	• **Jack Pine, Red Pine, White Oak,** Hemlock, Red Oak, White Pine, Red Maple, White Ash, White Birch, White Elm, Black Cherry, White Cedar
2. FRESH	• soil is well-drained • moisture capacity ideal for tree growth	• **Basswood, Beech, Butternut, Sugar Maple, White Pine,** Hemlock, Red Oak, Red Maple, White Ash, Ironwood, White Birch, White Elm, Largetooth Aspen, Black Cherry, White Cedar, White Birch, White Spruce
3. MOIST	• standing water seasonally present • soils imperfectly drained	• **Balsam Fir, Green Ash, Bitternut Hickory, Black Walnut, Bur Oak, Trembling Aspen,** Red Maple, Silver Maple, White Ash, White Birch, White Elm, Black Cherry, White Cedar, Ironwood, White Spruce, Tamarack
4. WET	• standing water usually present • poorly drained organic soils	• **Willow, Alder, Black Ash, Tamarack,** White Cedar, Balsam Fir, Green Ash, Red Maple

***Species composition* will change with slope position based on species' moisture requirements. Towards the top of the slope, species such as Sugar Maple, Beech and Hemlock will grow on "fresh" sites. Towards the bottom, species such as Red Maple, Balsam Fir, and Tamarack will grow on "moist" sites.**



NUTRIENT REQUIREMENTS

Trees need nutrients to grow. Most trees can grow on a range of sites. Soil nutrient availability is related to a number of factors, including:

soil texture

- ▸ clay soils: tend to be more fertile
- ▸ loamy soils: intermediate in fertility
- ▸ sandy soils: tend to be less fertile

soil pH

- ▸ most trees prefer a pH in the range of 5.5–7.5
- ▸ when the pH of a soil is above (more alkaline) or below (more acidic) this range, some nutrients may become unavailable to the plant.

Red Pine does not do well on high lime soils. *Carbonates* within 50 cm (20 in.) of the soil surface can eventually kill Red Pine and may impact the growth of White Pine, White Spruce and Norway Spruce.

SOIL TYPE	POTENTIALLY LIMITING NUTRIENT*
HIGH pH (ALKALINE)	Boron, calcium, copper, iron, manganese, phosphorous, zinc
LOW pH (ACID)	Boron, calcium, molybdenum, phosphorous, potassium

* when amount of available nutrient is insufficient for optimal growth

For more information about soil pH and woodlands, see *Establishing Tree Cover,* the second title in this two-volume series.

SEEDBED REQUIREMENTS

Many trees have specific requirements for the type of seedbed needed for germination and survival. Seed characteristics vary widely from species to species.

Small seeds can penetrate thick sod. For example, White Elm and White Pine will often germinate in abandoned agricultural land, whereas the spinning action of Maple seeds helps them penetrate thick layers of leaf litter. Oak are partially dependent on wildlife to spread and bury their acorns.

Yellow Birch is a prolific seed producer – but few of these seeds germinate or survive. Yellow Birch seeds require exposed mineral soil or humus as well as the right amount of light and moisture to germinate and survive. Sometimes the only suitable sites are decaying stumps or mossy logs.

Tree roots can exert extreme forces to penetrate fissures and crevices on shallow to bedrock soils.

WOODLAND GROWTH – FOREST DYNAMICS AND CHANGE

A forest is an interconnected association of trees, plants, wetlands, insects, diseases and wildlife. Each forest is also in a constant state of change as the individual components in it grow, reproduce and eventually die. The mechanism that drives this change is a dynamic one based on a number of factors summarized in the next chart.

CATALYSTS FOR CHANGE IN FORESTS

FACTOR	EXPLANATION	EXAMPLES
SILVICS AND SITE CONDITIONS	• Species-specific growth requirements	• Upland trees intolerant of high water tables
FOREST GROWTH AND DYNAMICS	• Competition for space, light, soil rooting volume, moisture and nutrients as trees grow	• Woodland trees that out-compete their neighbours grow quicker and live longer
NATURAL FORCES	• Natural factors that affect tree growth, reproduction and mortality	• Wind, fire, insects, and disease • Ice accumulations
HUMAN IMPACTS	• Past land use and management practices	• Grazing, clear-cutting vs. carefully planned harvests

WOODLAND GROWTH AND TREE CROWN FORM

Crown form or shape is important because it influences the amount and quality of the wood produced. Crown form may also vary depending on where the tree is growing. Open-grown trees often have a crown that is too large and branchy to produce valuable saw logs (although large crowns are indicators of relatively high sap sugar content for maple syrup). Forest-grown trees in *stands* that are quite dense often have small crowns that can't support good growth. As a result these trees tend to be less vigorous, growing more slowly in diameter. Smaller, narrower crowns often result in permanently stunted trees that won't respond well, even if nearby trees are removed and exposure to sunlight is increased.

Tree grown in forest.

Tree grown in open field.

Widely spaced trees growing in open fields are not affected by competition from neighbours. As a result, they tend to grow to a shape that is characteristic of the species. Generally, the open-grown White Pine tends to hang onto most of its branches. The form of the forest-grown White Pine is quite different. Competition from other trees shades out the lower branches as the tree grows in height. With proper management, the mature, forest-grown White Pine has a long, straight, relatively branch-free trunk that's often more valuable than the open-grown tree.

Crown position and size are important because trees with larger crowns tend to support higher levels of wood production. The crown position of a forest-grown tree can be classified into one of five general types.

1 = DOMINANT: A tree with a crown that is above the surrounding tree crowns and able to receive full sunlight. These trees are larger than the average trees in the stand and have well-developed crowns.

2 = CO-DOMINANT: Trees with crowns in the upper canopy and at the same level as one or more of the adjacent trees. These trees receive sun from above and usually have medium-sized crowns.

3 = INTERMEDIATE TREES: Trees receiving little direct light from above or from the sides; usually with small, crowded crowns that are most often below the canopy formed by co-dominant trees.

4 = SUPPRESSED: Trees with crowns that are below the adjacent trees and receive no direct sunlight.

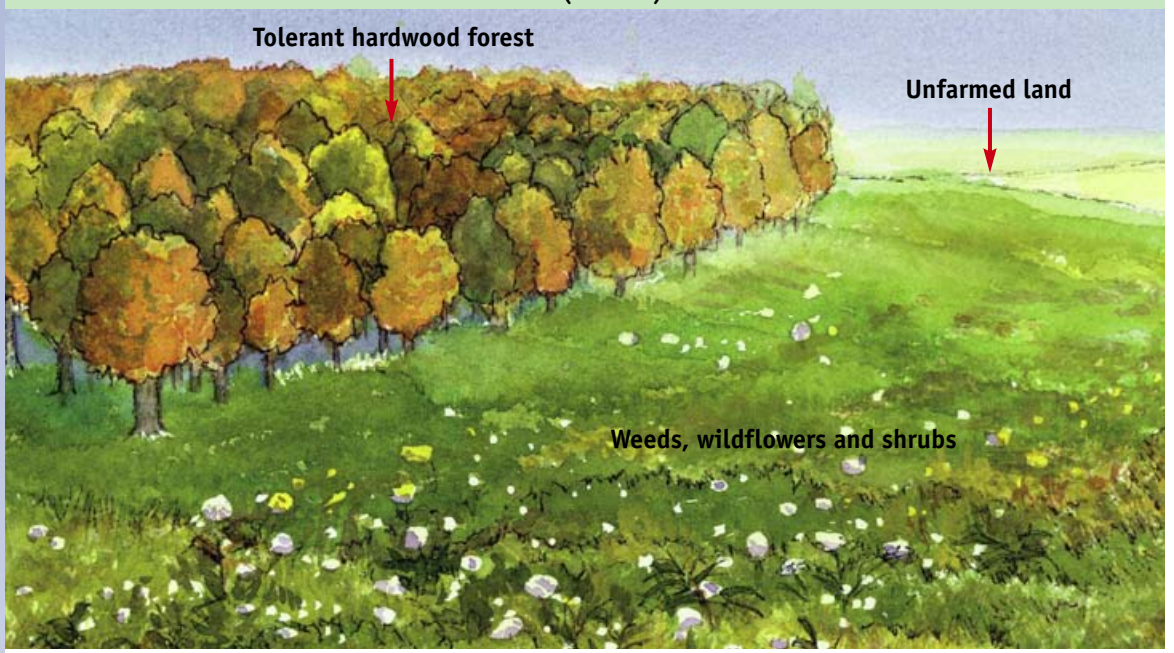
5 = UNDERSTORY: Young trees, shrubs and other plants growing beneath the tall, mature trees in a timber stand.

Forest management practices are designed to mimic the natural processes of change within a forest. By understanding what's happening now and what will happen in the future, you can make informed management decisions that will help you achieve your objectives for your woodlot.

SUCCESSION – A NATURAL PROCESS

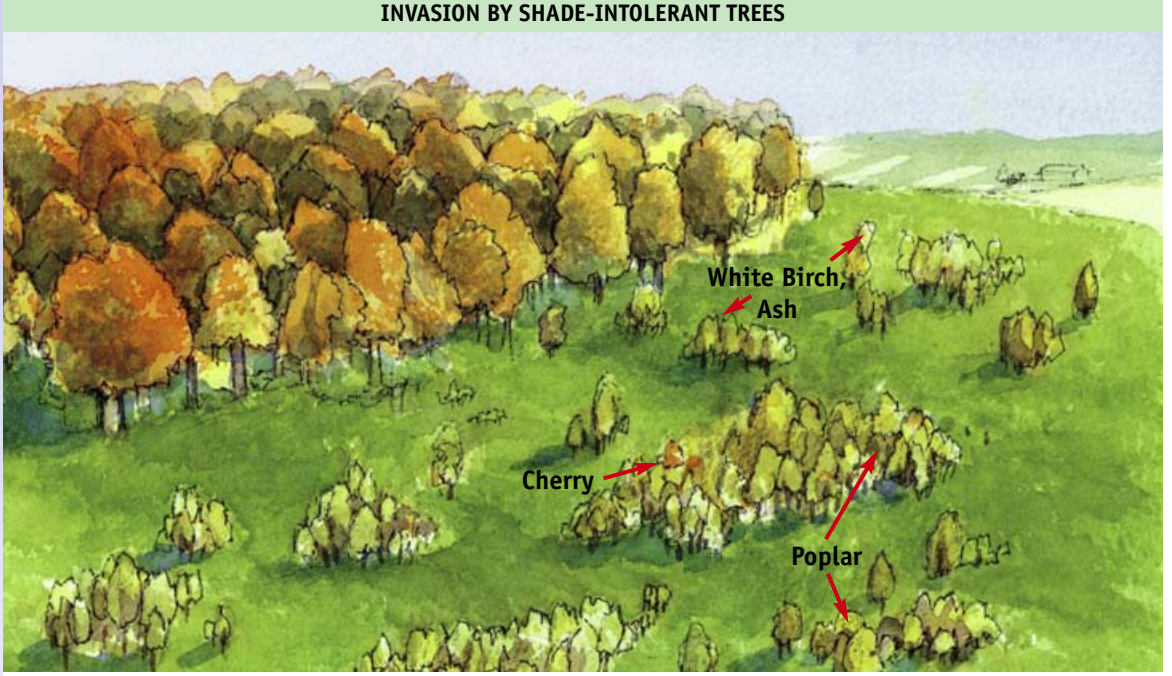
Succession is a natural and gradual process where existing plant species give way to new ones. Over many decades, a field that isn't cropped will convert to a forested state as sun-loving (shade-intolerant) pioneer tree species seed into the open area. Eventually, these trees will also be replaced by more shade-tolerant species capable of establishing themselves in the understory.

UNFARMED (FALLOW) LAND



At first, unfarmed or fallow land is colonized by weeds, herbs, forbs, grasses and shrubs that specialize in finding disturbed areas and reproducing rapidly. Eventually perennial plants such as grasses and wildflowers will move in and replace the original weedy species.

INVASION BY SHADE-INTOLERANT TREES

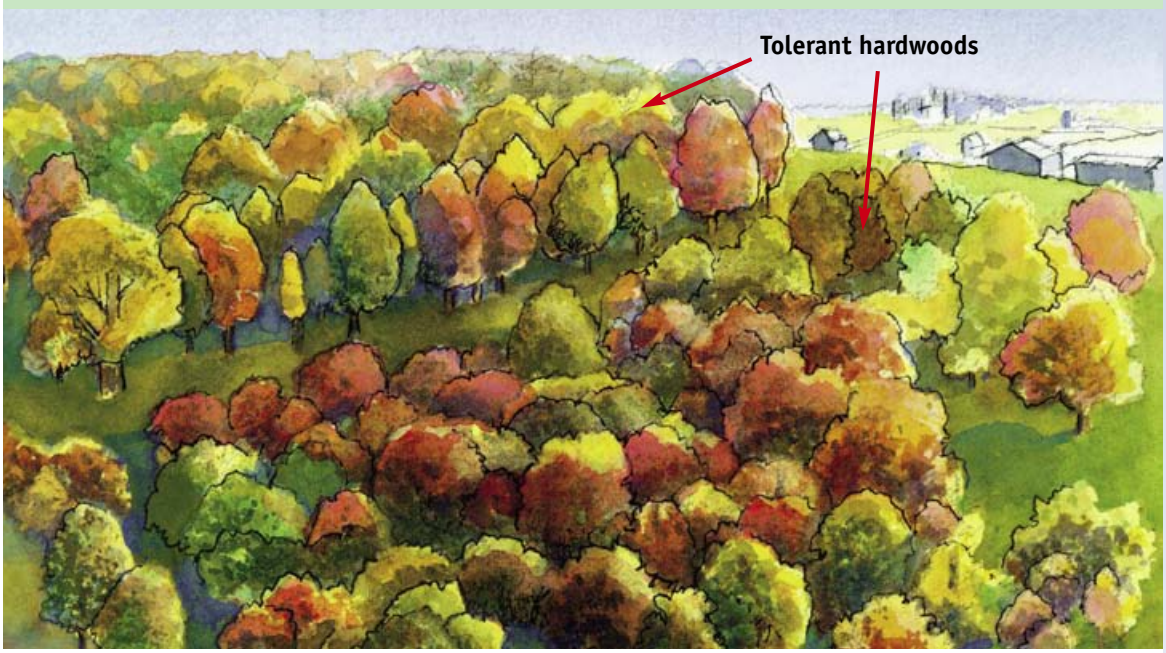


Over time, shade-intolerant pioneer species like White Birch, Ash, Poplar and Cherry will become established throughout the field. These fast-growing trees (pioneer species) are well-adapted to open sites and quickly grow to dominate the site. Maple as well as other shade-tolerant species are often not able to survive in open areas where grasses and other vegetation can out-compete them for nutrients, and especially moisture. Because most pioneer species are adapted to surviving on drier soil conditions, they are often better able to bear the heavy competition of the open field.

TRANSITION STAGE

Eventually the pioneer species will dominate the open site, creating shade on the forest floor that prevents them from reproducing. The closed canopy creates a favourable environment for more shade-tolerant species such as Sugar Maple and Red Maple that begin to become established in the understory.

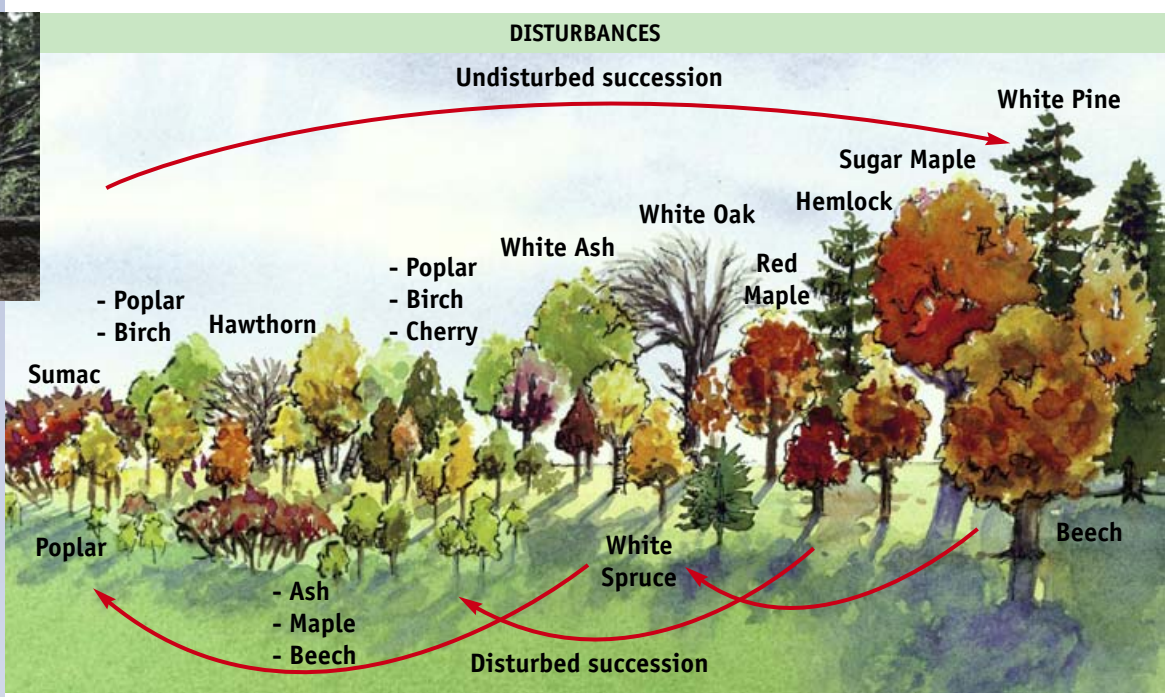
CLIMAX FOREST STAGE



Over time, the short-lived pioneer species die or are harvested, and the forest changes to one dominated by tolerant (climax) species.

DISTURBANCE

Were it not for disturbance, forest succession would follow a gradual and predictable course of events. Disturbance is a much more abrupt and random process of change that occurs as a result of insect infestation, disease, weather-related events and human intervention. Forest disturbance can adjust the course of succession by altering the structure or composition of a forest stand.



Major disturbances such as significant changes in the water table, wind, fire, insect/disease infestation, heavy harvests and ice damage will have a dramatic impact on the long-term development of a forest stand. Significant crown damage opens the stand up and changes the amount of light hitting the forest floor. In turn, the increased light levels have an impact on what type of species can and can't regenerate underneath.

Even-aged **conifer plantations are an excellent way to allow shade-tolerant hardwood forests to become established in the understory. Over time as the conifers are removed through thinning, the hardwoods will grow to eventually dominate the site.**

Similar to natural disturbances in a stand, harvesting trees can promote favourable regeneration. Removing individual trees or small groups of trees in a hardwood stand favours the regeneration of shade-tolerant species.

This canopy gap is large, favouring the regeneration of mid-tolerant species like Oak and White Pine.

WOODLANDS AS ECOSYSTEMS

Woodland ecosystems have two main components:

- physical – geological materials, soil, water table, slope, aspect, climate
- biological – tree vegetation, non-tree vegetation, microbes, insects, birds, mammals.

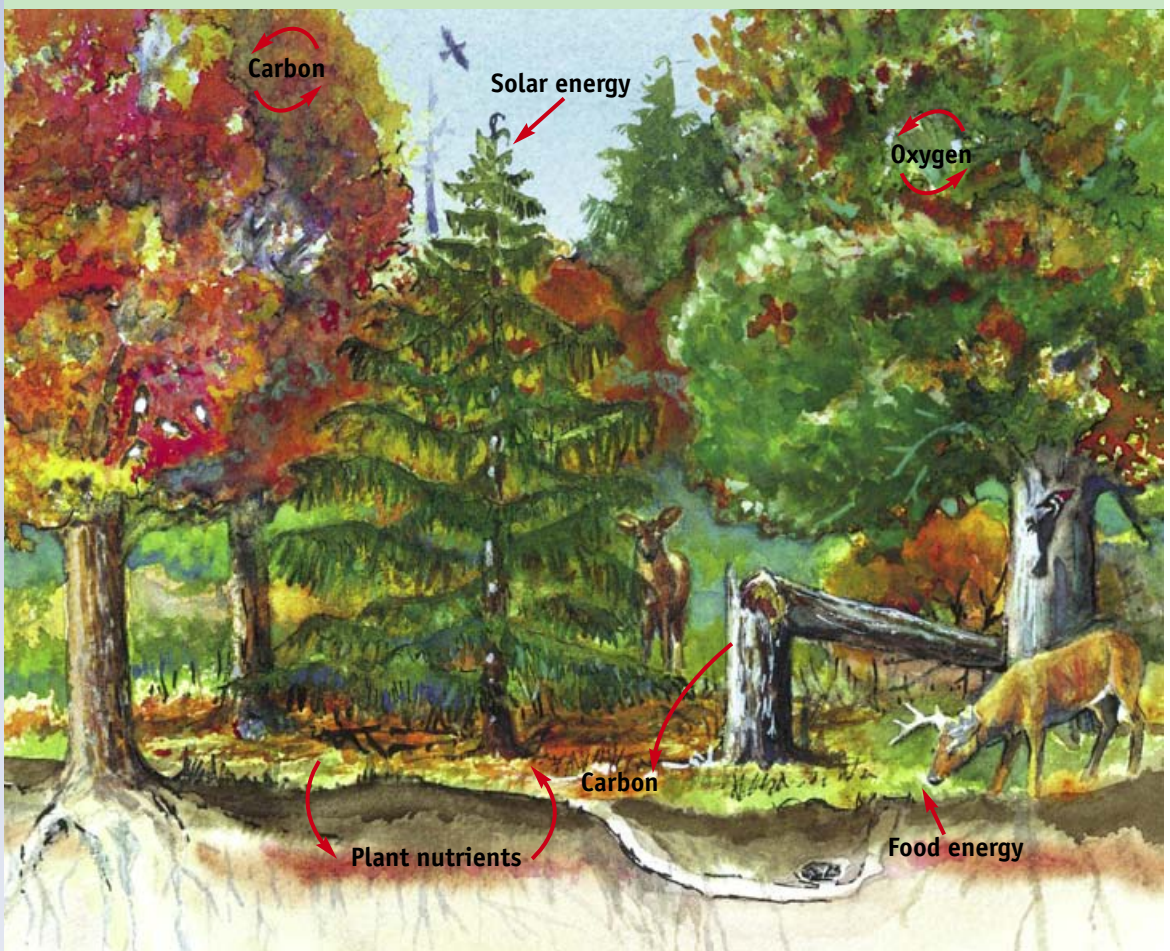
Woodland ecosystems are constantly cycling nutrients, organic matter and energy. For example, energy from the sun is transformed into plant materials. Plants feed animals. Microbes return plant and animal debris to the soil, which feeds the plants. Any severe disturbance of one key component (e.g., forest fire on forest vegetation) could have a profound impact on the ecosystem.

Woodland ecosystems include geological materials, soil, understory vegetation, seedlings, saplings and canopy trees – plus all the microbes, insects and other fauna that live within these layers of soil and vegetation.

The aftermath of a forest fire has significant implications for all life forms in a forest ecosystem.

Understanding woodland ecosystems helps to predict the impact and outcome of planned woodland management practices. For example, a harvest of an upland Ash-Hickory stand where more than one-third of the trees is removed may have minimal long-term impact on the woodland. However, a similar management practice in a lowland mixedwood may lead to higher water tables and excessive windthrow damage, and change the stand's species composition.

UPLAND HARDWOOD-HEMLOCK ECOSYSTEM



Woodland ecosystems are constantly changing and reacting to stress and disturbances. However, many woodland ecosystems eventually reach a steady state, where the forest composition remains similar for a manageable length of time. In these ecosystems, a particular community of forest vegetation and forest fauna will be commonly found in a specific and somewhat narrow range of site conditions. For example, tolerant hardwood ecosystems are normally found on well-drained loam soils, and lowland mixedwoods are found on poorly drained, coarse-textured to loamy soils.

1. Shagbark Hickory
2. Trilliums
3. Red Osier Dogwood
4. Swamp White Oak
5. Cardinal Flower

A. Red-bellied Woodpecker
B. Karner Blue Butterfly
C. Indigo Bunting
D. Wild Turkey
E. Prothonatory Warbler

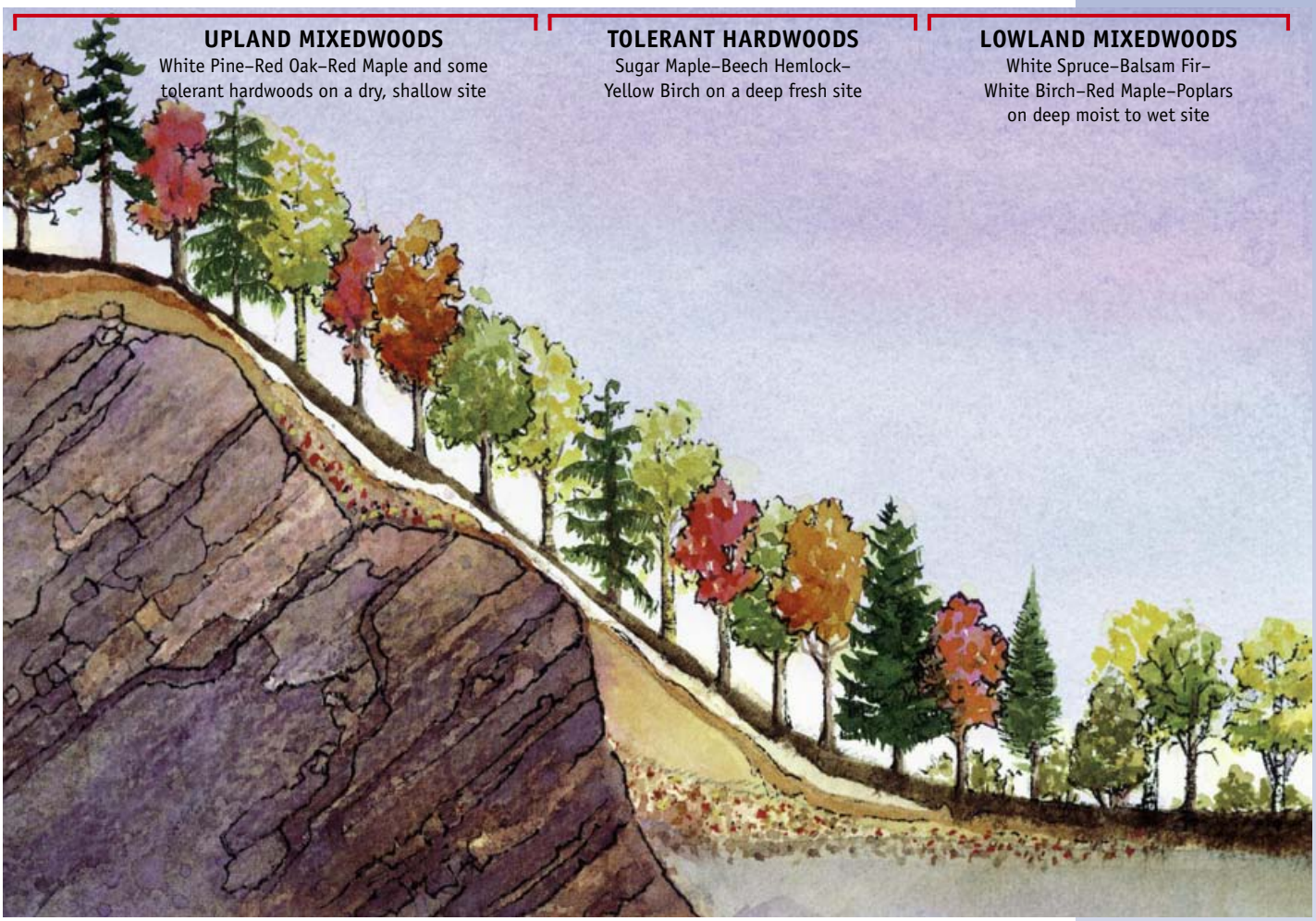
F. Red-shouldered Hawk
G. Flying Squirrel
H. Opossum

CAROLINIAN FOREST ECOSYSTEM

LOWLAND HARDWOOD (SWAMP) ECOSYSTEM

1. Silver Maple
2. Green Ash
3. Skunk Cabbage
4. Cinnamon Fern

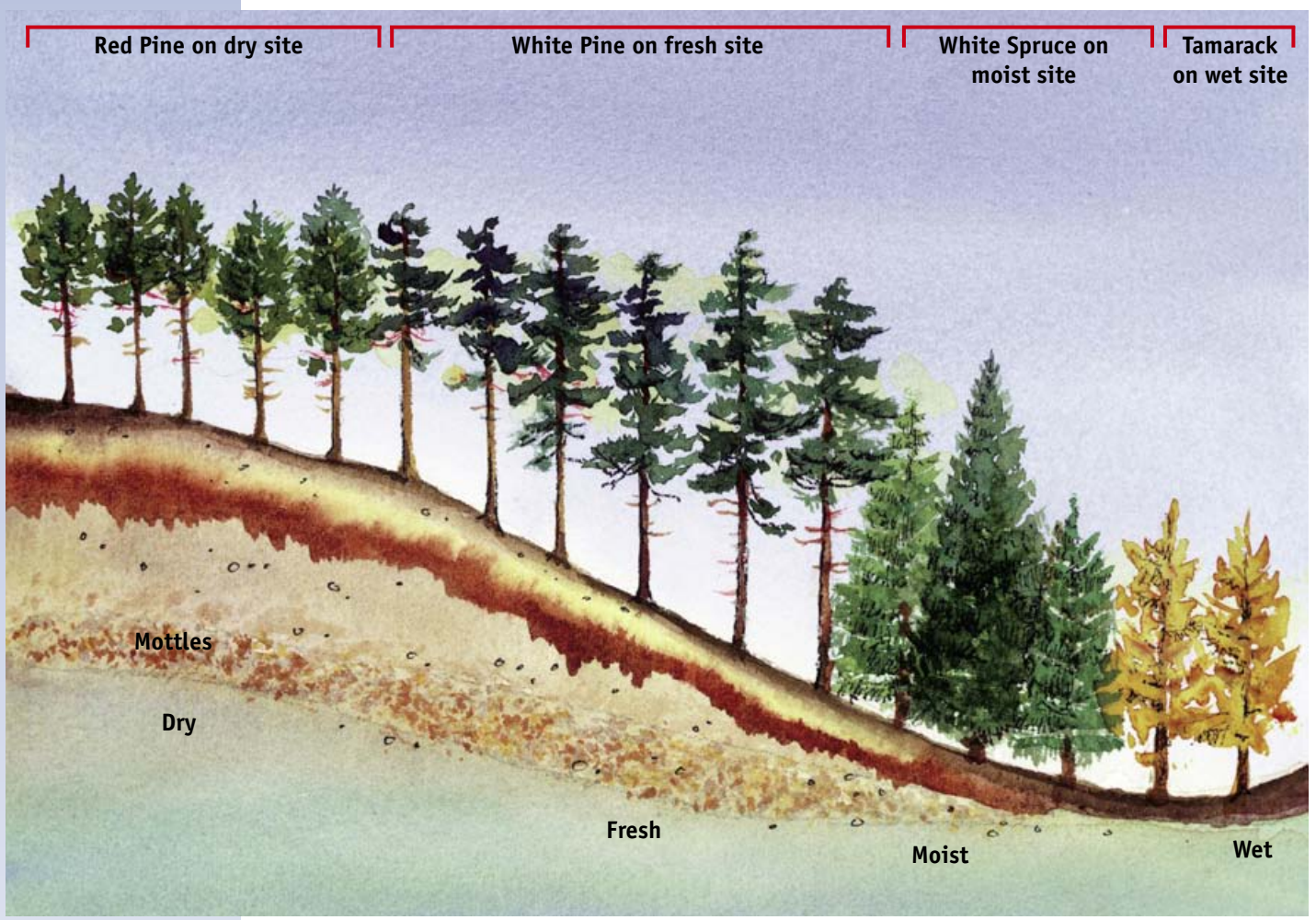
A. Midland Painted Turtle
B. Blue-spotted Salamander
C. Red-spotted Newt
D. Wood Ducks
E. Red-shouldered Hawk
F. Pileated Woodpecker



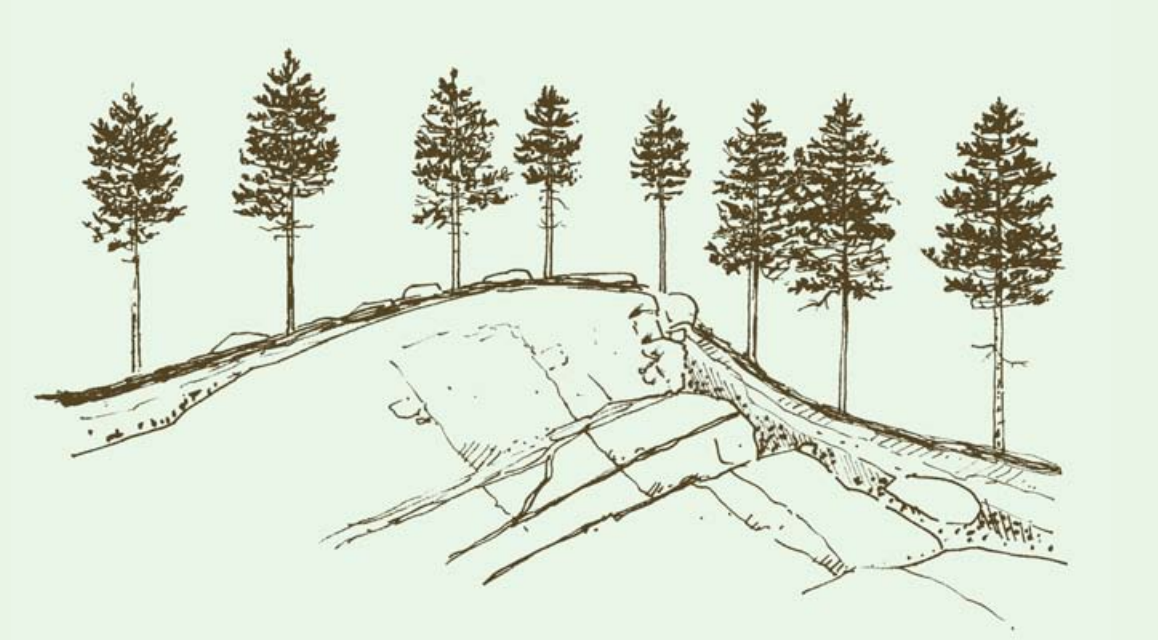
There are at least three distinctly different ecosystems depicted in this illustration: the Pine-Oak mixedwoods on the dry, shallow to bedrock site at the top of the slope; the tolerant hardwoods in the fresh, mid-slope position; and, the lowland mixedwoods in the moist-wet, lower slope position. For forest management planning, these ecosystems should be treated differently.

SITE CONSIDERATIONS

Whether you're establishing a new forest or managing an existing one, it is important to understand the soil and site characteristics that influence tree growth and survival. Soil and site characteristics influence the commercial potential of the stand. They dictate what will grow well on the site.



The healthy and fast-growing trees in this mixed conifer plantation have been matched properly to existing site conditions. Trees not planted on the right site (off-site plantings) will not thrive.



This illustration shows how soil depth can influence tree height. A stand of Red Pine tends to grow to the same height unless the trees are affected by poorer site conditions. In this case, the trees growing on the shallower soils (poorer site) are noticeably shorter than those on the deeper soils.

BIOLOGICAL COMPONENT

BIODIVERSITY

Biological diversity or biodiversity refers to the variety of life, expressed as a measure of the variety and genetic diversity within ecosystems. It refers to the total number of different "types" of living organisms.

The loss of biological diversity is a growing global concern. In Canada, more than 200 species are considered threatened or endangered and many more are of provincial or local conservation concern.

Biodiversity sustains life on Earth and has a direct impact on the health of Ontarians. Ontario is helping protect our natural heritage of plants, animals, and ecosystems with its Biodiversity Strategy.

To some, conserving biological diversity and conducting a profitable forest harvesting operation have been considered incompatible activities. However, over the last few decades our understanding of the ecological processes that promote the maintenance of biological diversity has improved. By promoting some of the features listed in the following sequence of photographs, you can help reduce any negative impacts that forestry and agricultural operations have on these ecological processes.

Biodiversity is the variety of life at all levels, from the smallest insect to the largest forest.

Old-growth forests are biologically diverse. Old-growth forests have multi-layered canopies (including super-canopied trees) and a high degree of tree species diversity (including mid-tolerant). They have an abundance of large-diameter, living and dead trees, cavity trees, and downed, woody debris.

OLD-GROWTH FOREST

Uprooted trees create small pits and mounds that provide habitat for plants as well as vital breeding locations for amphibians in the early spring.

Deadwood on the forest floor plays an important ecological role by providing food and habitat for numerous species.

Large trees that extend well above the forest canopy provide roosting habitat for several species of birds and mammals.

Large trees provide important cavity nesting sites for birds and other wildlife.

INVASIVE SPECIES THREATEN BIODIVERSITY

Non-native or introduced species can pose a significant threat to ecosystem function and biodiversity. There are a number of terms often used interchangeably to describe introduced species, including exotic, alien, and invasive.

Invasive species pose a significant threat to the biological diversity of an area. They have the ability to:

- flourish – they have few predators, produce large numbers of offspring and can survive over a broad range of habitat types
- dominate an ecosystem – they push out native plants and animals and prevent the establishment of desirable species.

It is estimated that Canada's list of invasive species includes:

- one-quarter of the 5,000 plant species
- 180 forest insect pests
- hundreds of other insect species
- an undetermined number of fish, molluscs, mammals, and diseases.

The Emerald Ash Borer is killing Ash trees in parts of southwestern Ontario. Well-adapted to Ontario's climate, it poses a serious threat to North American forests.

European Buckthorn was imported as a landscape shrub from Europe in the late 19th century and has since spread to much of southern Ontario. It is an alternate host for the fungus that causes leaf and crown rusts on oats.

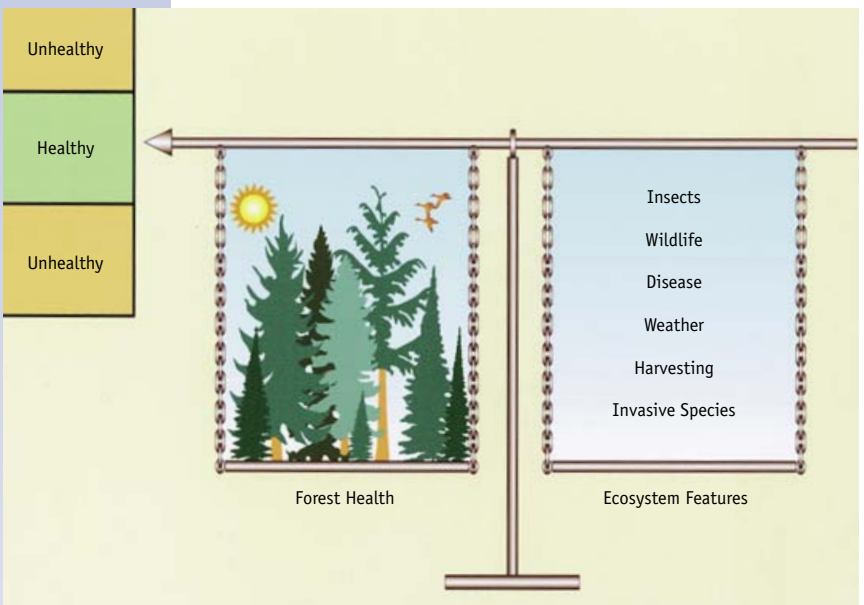
FOREST HEALTH

Forest health is an important issue that should be considered when making management decisions about your woodlot. There are certain basic things that you need to consider to determine whether your woodlot is healthy. Ask yourself:

- is the forest growing well?
- are many of the trees declining or having insect or disease problems?
- has a recent drought left the forest more vulnerable to other problems?

A healthy forest ecosystem can be thought of as one with a natural balance of organisms, each with its own role to play in the maintenance of that ecosystem. Biological diversity, soil productivity, and natural disturbances are ecosystem features that, when in balance, help maintain forest health. It will be important to judge on an ongoing basis whether the health of the forest has changed over time.

Worksheet #23 in the *Environmental Farm Plan Workbook* suggests several actions farmers should take to determine whether their woodlots are healthy or unhealthy.



Woodland health is a balance of ecosystem features that include wildlife, trees, plants, insects, disease, and human activity – too many or too few of one particular feature can tip the balance and result in an unhealthy forest. If your forest is unhealthy, it may require corrective action or a change in your management plans to bring it back into balance.

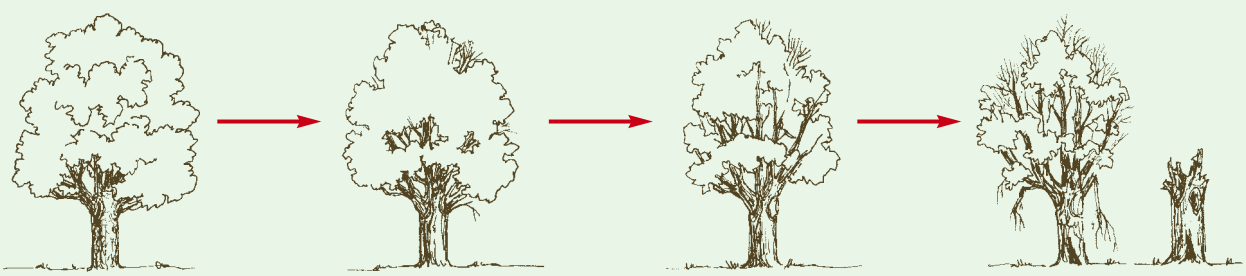
One way to help maintain a healthy woodlot is to "scout it" three to four times a year to check for degradation, unauthorized use, forest pests or disease, and the presence of invasive species.

TREE STRESS

Trees are affected by stress. Stress weakens a tree, in turn making it more susceptible to the impacts of other living *(biotic)* and non-living *(abiotic)* stressors. Tree death seldom occurs by one stressor alone. Most trees are weakened by one stress, making them more susceptible to secondary stressors that may attack and kill the weakened tree.

Forest Tent Caterpillars can completely defoliate a tree each spring for two or three years in a row. Many trees are adapted to this type of stress and will usually send out a new set of leaves, helping it complete its annual life cycle. However, if the tree is impacted by another stress like a summer drought or another type of insect, it may weaken, decline, and eventually die.

LIFE CYCLE



Trees seldom die quickly. Instead they tend to decline slowly over time, losing vigour until they are no longer able to sustain life. Decline is caused by stresses like insects, disease, and weather. In the early stages of decline, trees will often recover if the stress is reduced. If the decline is severe, however, a tree may not be able to recover even if the stress is alleviated.

Oak trees are susceptible to a wide number of insect and disease stressors including:

- **defoliators – Forest Tent Caterpillar, Oakworm (several species), Gypsy Moth Caterpillar (pictured) (invasive) and Fall Cankerworm**
- **stem/wood insects – Carpenter Worm (borer), Carpenter Ant and Two-lined Chestnut Borer**
- **diseases – Armillaria Root Rot, Oak Wilt (not yet reported in Ontario), Sudden Oak Death (not yet reported in Ontario).**

Repeated insect problems may weaken a tree, making it more susceptible to other stressors. Armillaria is currently the only significant disease affecting Oak in Ontario. However, Oak Wilt and Sudden Oak Death Syndrome are moving this way from the United States and represent a very serious threat to our Oak species.

Insects and disease are not the only factors affecting forest health. Ice storms, wind damage, forest fire and human impacts from logging can have a dramatic effect on forest health.

Weather-related events like drought, ice and windstorms can have a serious impact on forest health. Damage like this can take both forests and trees decades to recover from.

WOODLAND TYPES

Forest trees can grow in a variety of conditions and sites, and over a wide geographic area. Red Oak, for instance, can be found growing across southern Ontario and as far north as Temagami.

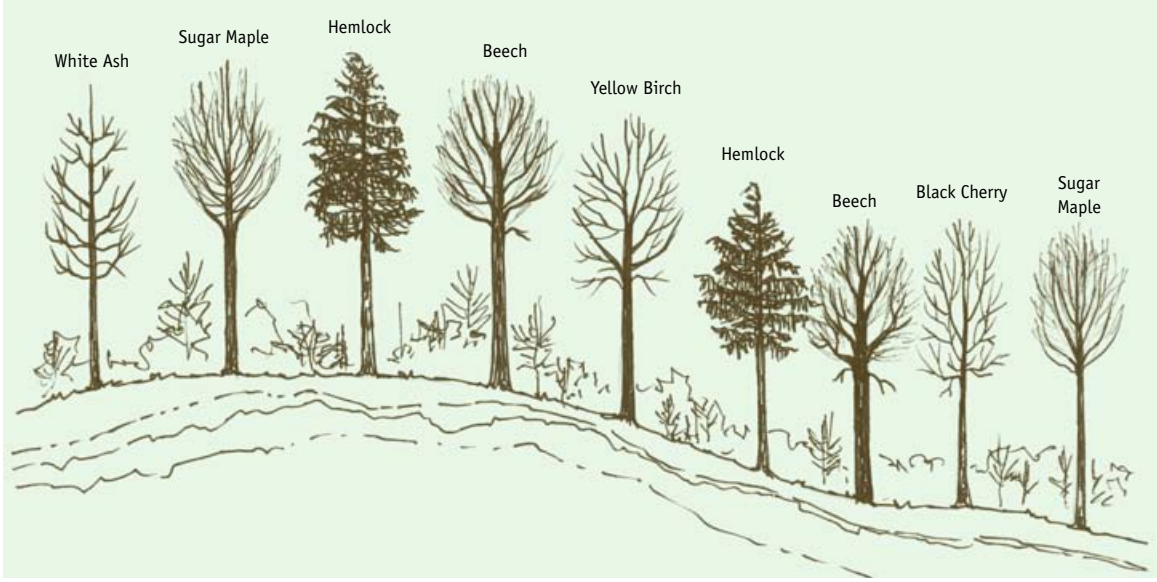
The presence and quality of any given tree species on a site depends on:

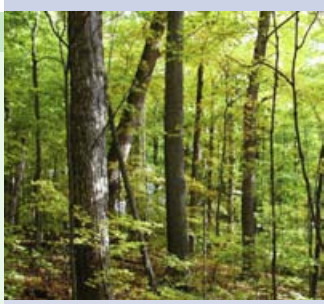
- soil and site conditions
- tolerance to overstory shade
- length of growing season
- disturbances, both natural and man-made
- competition from other trees and vegetation
- presence of a nearby seed source, if of seed origin.

Many tree species are commonly found together under similar circumstances. These associations of species that thrive under similar conditions are often called forest cover types or *working groups.*

For the purposes of this book, forest cover types have been simplified into six working groups based on common species, soil and site preferences, ecological adaptations and position in the landscape. These six types are listed in the first column of the chart on the next page. **Bolded** species in the table are those that dominate the working group. Other (non-bolded) species are commonly found in the working group but generally don't dominate it.

TOLERANT HARDWOODS AND HEMLOCK





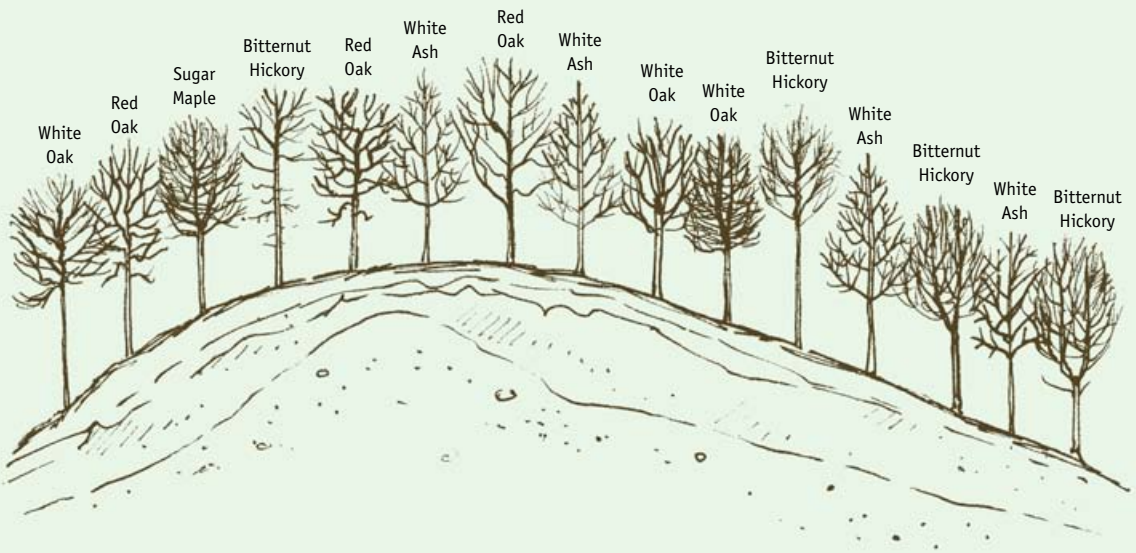
Tolerant hardwoods consist mostly of Sugar Maple, Beech and Hemlock. They're usually found on well-drained soils throughout southern Ontario.

WOODLAND TYPES – KEY CHARACTERISTICS

WORKING GROUP	COMMON TREE SPECIES	CAROLINIAN ADDITIONS	TYPICAL SOIL AND SITE TYPE	TYPICAL LOCATIONS AND LANDFORMS	ECOLOGICAL ADAPTATION SYSTEMS	MOST SUITABLE MANAGEMENT
TOLERANT HARDWOODS AND HEMLOCK	• **Sugar Maple, Beech, Hemlock** • White Ash, Black Cherry, Basswood, Yellow Birch, Hemlock	• Tulip Tree • Sassafras • Hackberry • Sycamore	• dry to fresh moisture conditions (well-drained), shallow to deep soil • well-drained sandy loams to clay loams	• moderately shallow to deep fertile soils on ground moraine drumlins and end moraines	• shade-tolerant	• single tree selection • *group selection*
UPLAND MID-TOLERANT HARDWOODS	• **White Ash, Bitternut Hickory, Red Oak** • White Oak, Green Ash	• Pignut Hickory • Black Oak	• fresh to moist (well-drained to imperfectly drained) deep soils	• deep fertile ground moraines • end moraines • loess and lacustrine soils	• intermediate shade-tolerant	• modified shelterwood • group selection
UPLAND MIXEDWOODS	• **White Pine, Red Oak, White Oak, Red Pine** • Red Maple, White Ash, Sugar Maple	• Black Oak • Chinquapin Oak • Kentucky Coffee Tree	• dry to fresh moisture conditions • shallow to very shallow soils with good drainage • sandy sites	• Canadian Shield dry rock ridges • top of bedrock-controlled drumlins • sandy soils (dunes and beaches)	• adapted to fire and dry soil conditions	• uniform shelterwood
EARLY SUCCESSIONAL HARDWOODS	• **Trembling Aspen, Largetooth Aspen, White Birch** • Black Cherry, Green Ash, White Pine	• Sassafras • Tulip Tree	• most soil types	• most sites – less common on moist sites	• adapted to colonizing disturbed sites • heavy production of light seeds	• modified clearcut
LOWLAND HARDWOODS	• **Red Maple, Silver Maple, Green Ash, Black Ash, Elms, Bur Oak** • Yellow Birch, White Birch	• Hackberry • Swamp White Oak • Big Shellbark Hickory	• moist to wet soil conditions • moist mineral soil • organic soils • poor drainage	• swamps • moist soil around wetlands, lakes, outwash plains • lacustrine plains	• tolerant of flooding	• group selection • shelterwood • single tree selection (upland)
CEDAR AND LOWLAND MIXEDWOODS	• **White Cedar** • White Birch, Trembling Aspen, Balsam Poplar, White Spruce, Balsam Fir, Tamarack		• very dry, shallow sites • moist to wet soil conditions • nutrient-poor sites	• shallow limestone plains • high-lime soils • swamps	• adapted to extremely dry and wet conditions	• shelterwood • patch/strip • clearcut

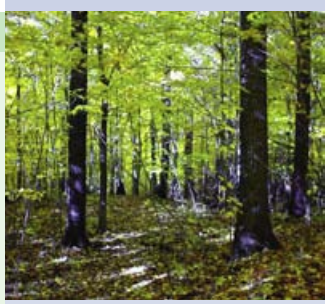
Adapted from *Silvicultural Guide to Managing Southern Ontario Forests,* Ontario Ministry of Natural Resources

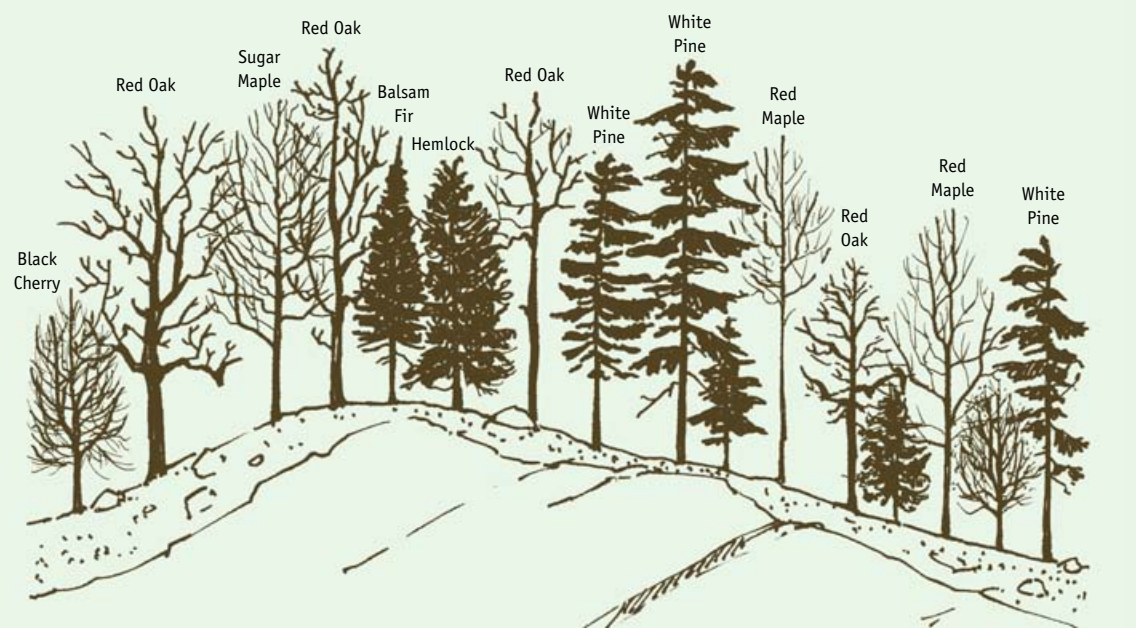
UPLAND MID-TOLERANT HARDWOODS



The most common trees in upland mid-tolerant hardwood forests are Oak, Ash and Hickory. Most stands are found on fresh to moist deep soils.

UPLAND MIXEDWOODS

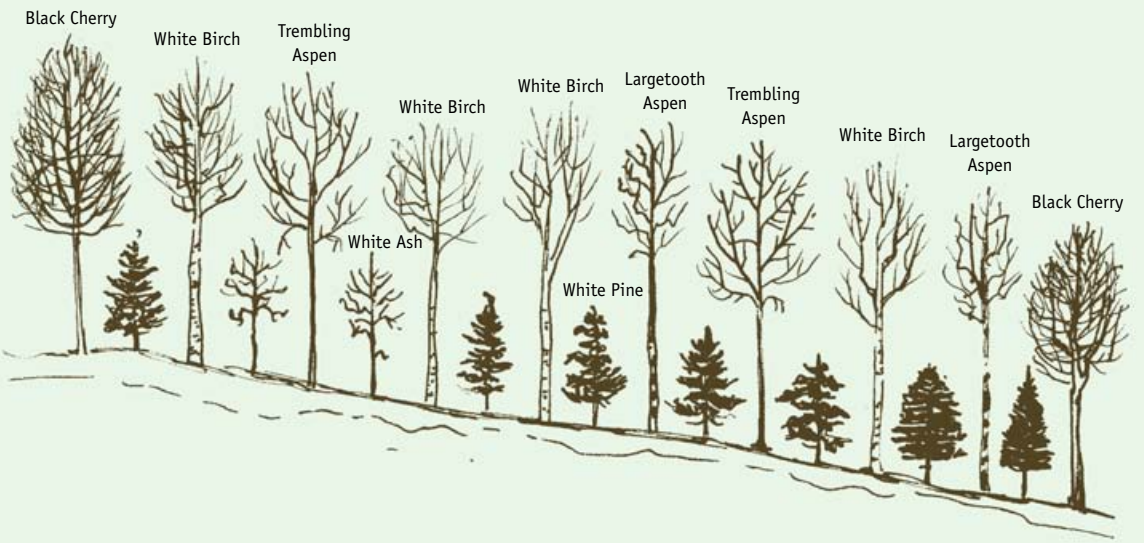




Pine and Oak dominate the upland mixedwoods working group. These forests are usually found on dry to fresh shallow sites in central and eastern Ontario.

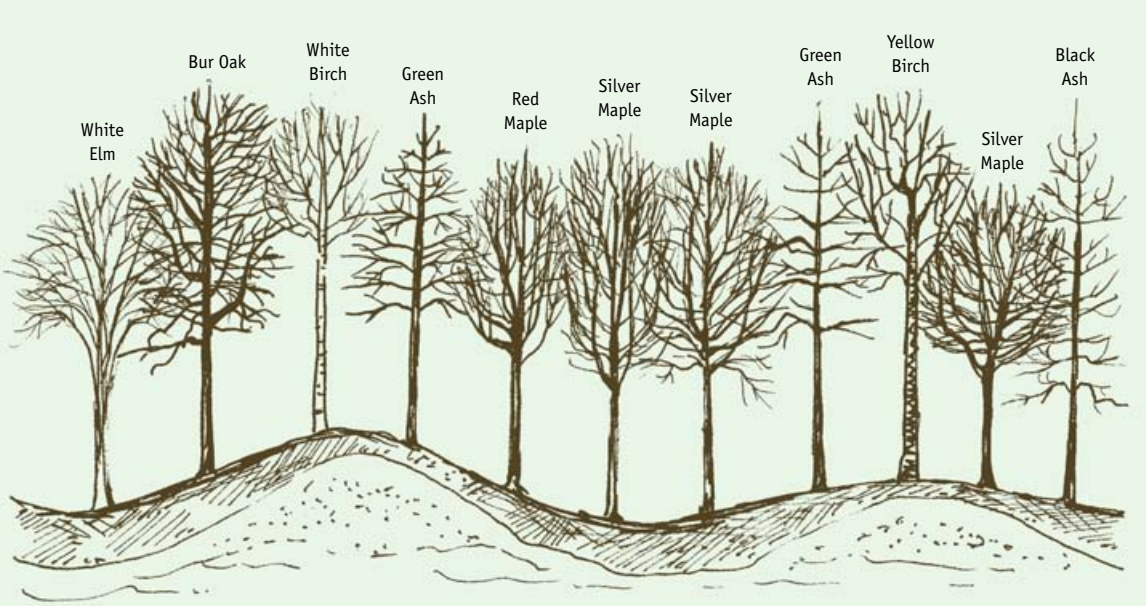
Your woodland may have a number of species from other working groups. For example, in some woodlands, groups of early successional species such as White Birch and Trembling Aspen can be found growing with tolerant hardwood species.

EARLY SUCCESSIONAL HARDWOODS



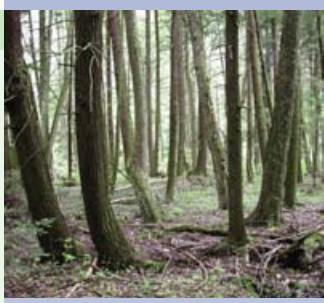
Poplar species and White Birch with a conifer or hardwood understory typify this working group, which grows on a wide range of sites and is most common in eastern Ontario.

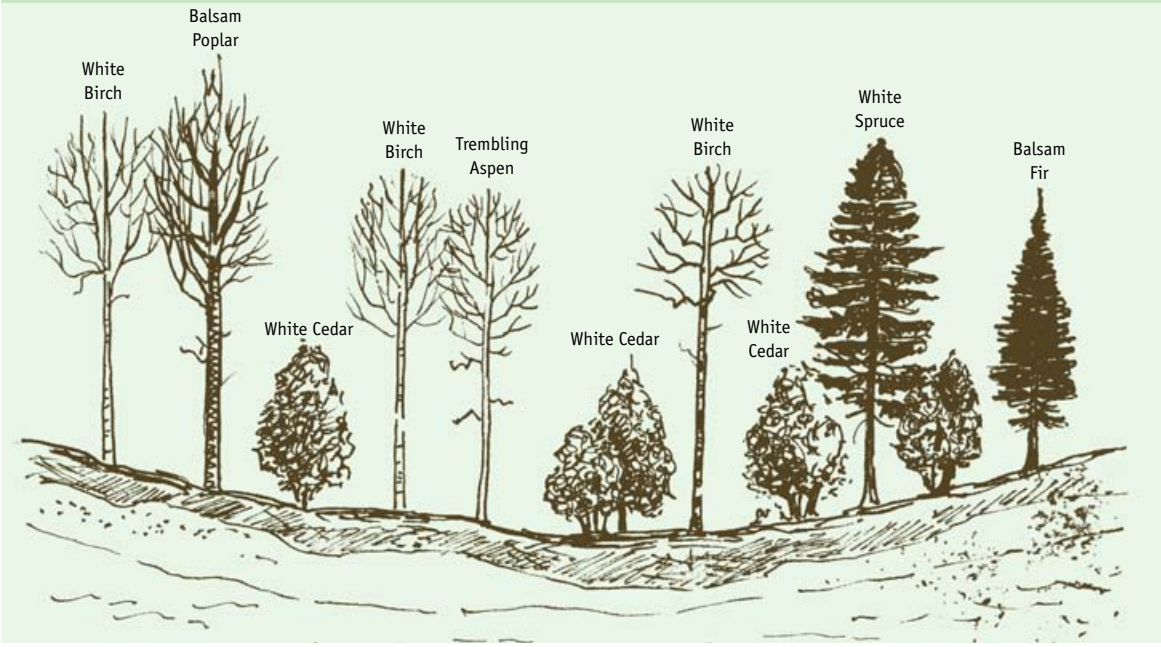
LOWLAND HARDWOODS



Lowland hardwoods consist mostly of Ash, Maple and Birch species that prefer moist to wet sites.

LOWLAND MIXEDWOODS





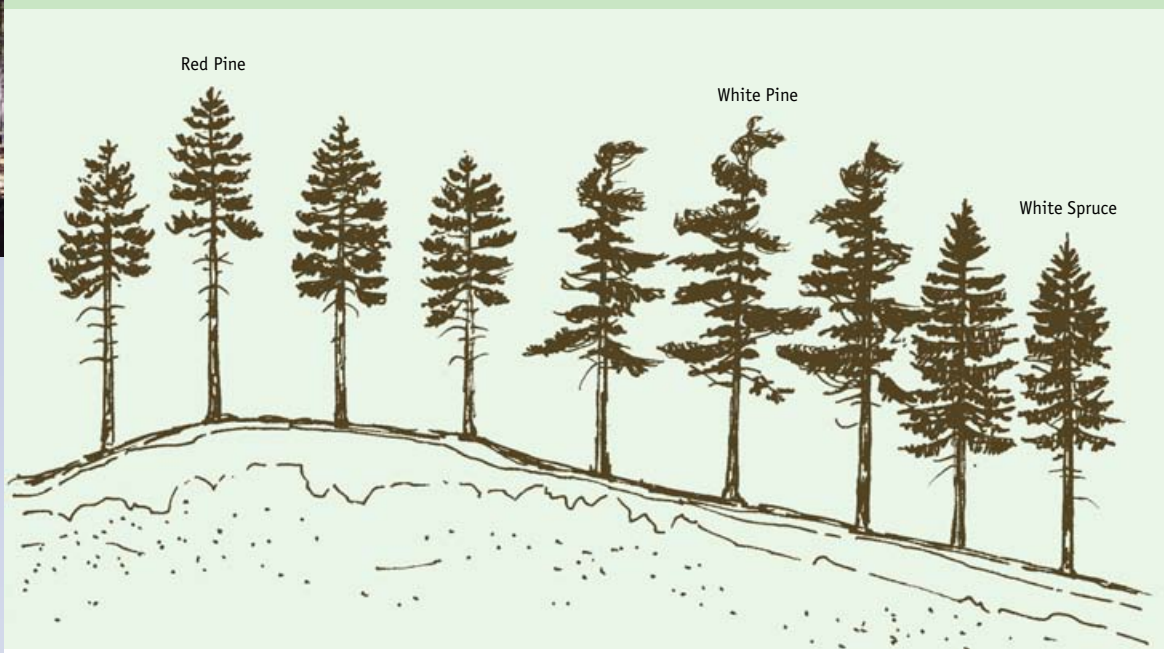
Lowland mixedwoods are found on cool moist to wet sites and consist of conifers (Cedar, Spruce, Fir and Tamarack) as well as hardwoods (Birch, Poplar and Ash).

PLANTATION TYPES

Most established plantations found in Ontario are made up of:

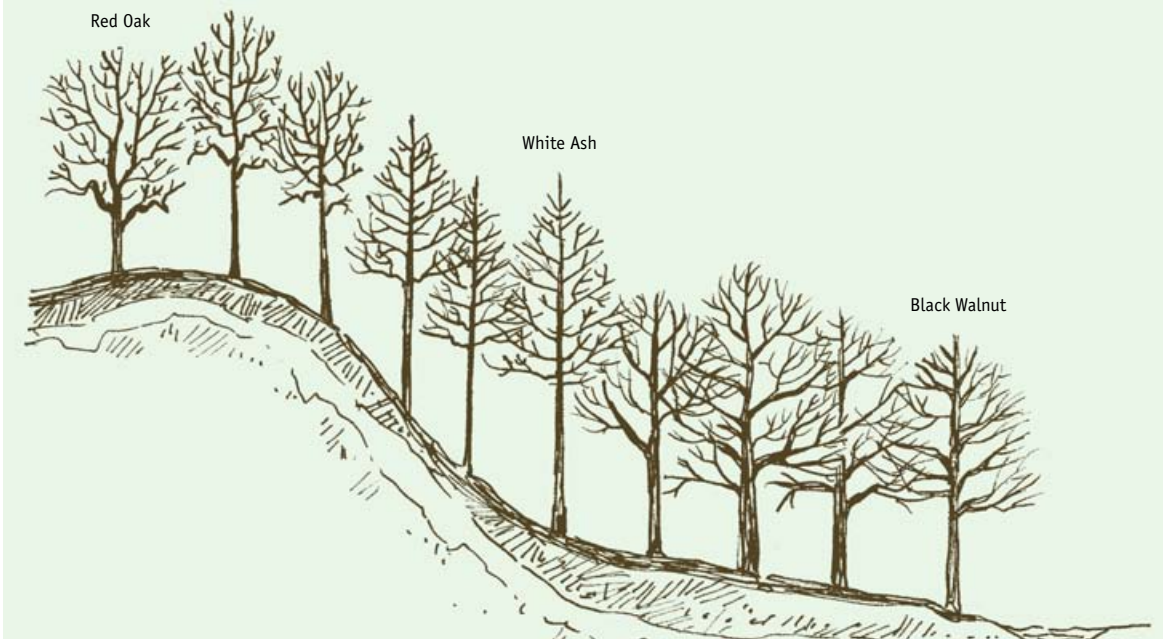
- ▶ conifers – single or multiple species
- ▶ hardwoods – single or multiple species
- ▶ mixedwoods – a mix of conifer and hardwoods and in some cases, shrubs
- ▶ specialty plantations – fibre, *biomass*, Maple, orchards, Christmas trees

CONIFER PLANTATION SPECIES



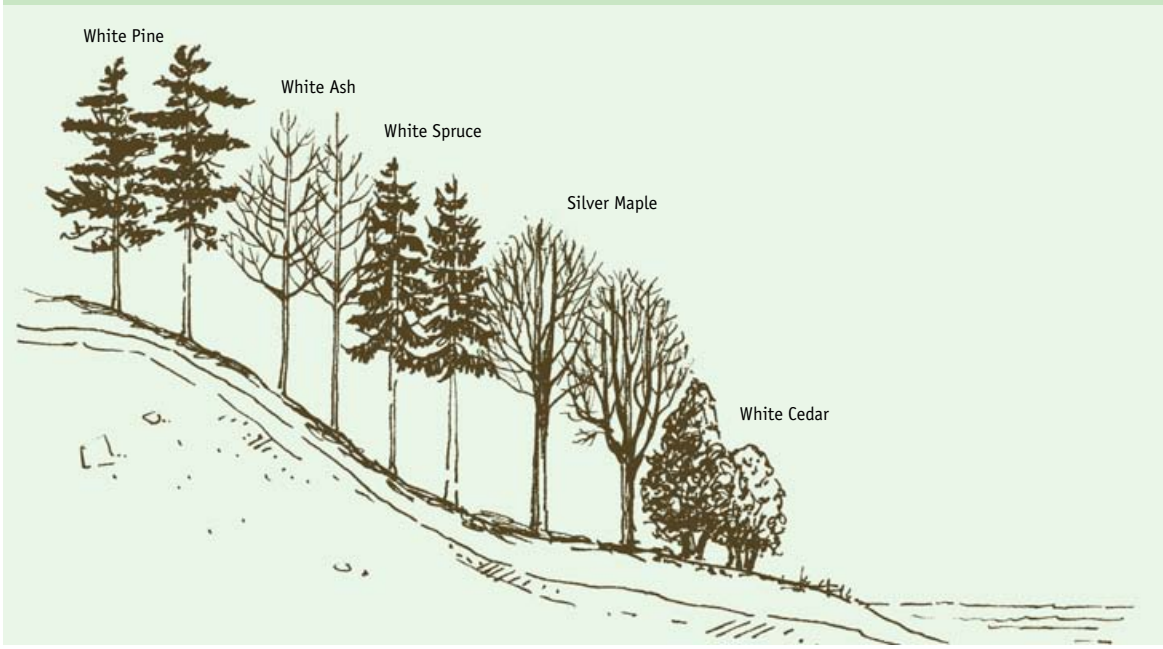
Pine, Spruce and other conifer species are normally found as single-species or mixed conifer plantations.

HARDWOOD PLANTATION



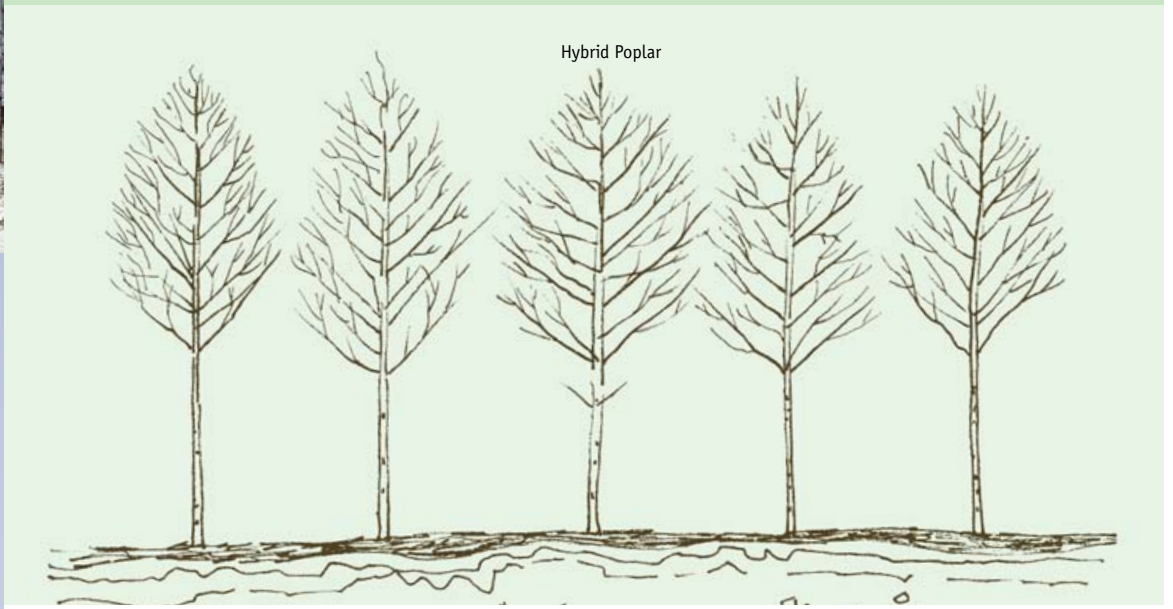
Plantations of valuable hardwoods can be found on deep, well-drained sites.

MIXEDWOOD PLANTATION



Mixedwood plantations are found on conservation lands in southern Ontario.

SPECIALTY PLANTATION



Specialty plantations are stands established for a specialized purpose such as pulpwood, biomass for energy, or maple sap for syrup production.

A Maple plantation adjoins a natural sugar bush. Maple plantations that have been established to produce large volumes of sweet sap are called Maple orchards in Ontario.

WOODLOT MANAGEMENT PLANNING

Woodlot management requires forethought. Some initial planning can help you turn your intentions into reality. Planning helps you:

- ▶ organize and document your ideas
- ▶ set and achieve your goals
- ▶ avoid costly mistakes
- ▶ ensure that resources are well-managed
- ▶ maximize potential returns
- ▶ monitor your progress
- ▶ prepare for the tax implications of owning a woodlot.

Planning embraces managing what you've got and planning for what you could have. For example, right now you may have a woodlot in need of harvest. A comprehensive plan will help you schedule the harvest. It will also very likely bring other agroforestry opportunities to your attention (e.g. non-wood products, afforestation).

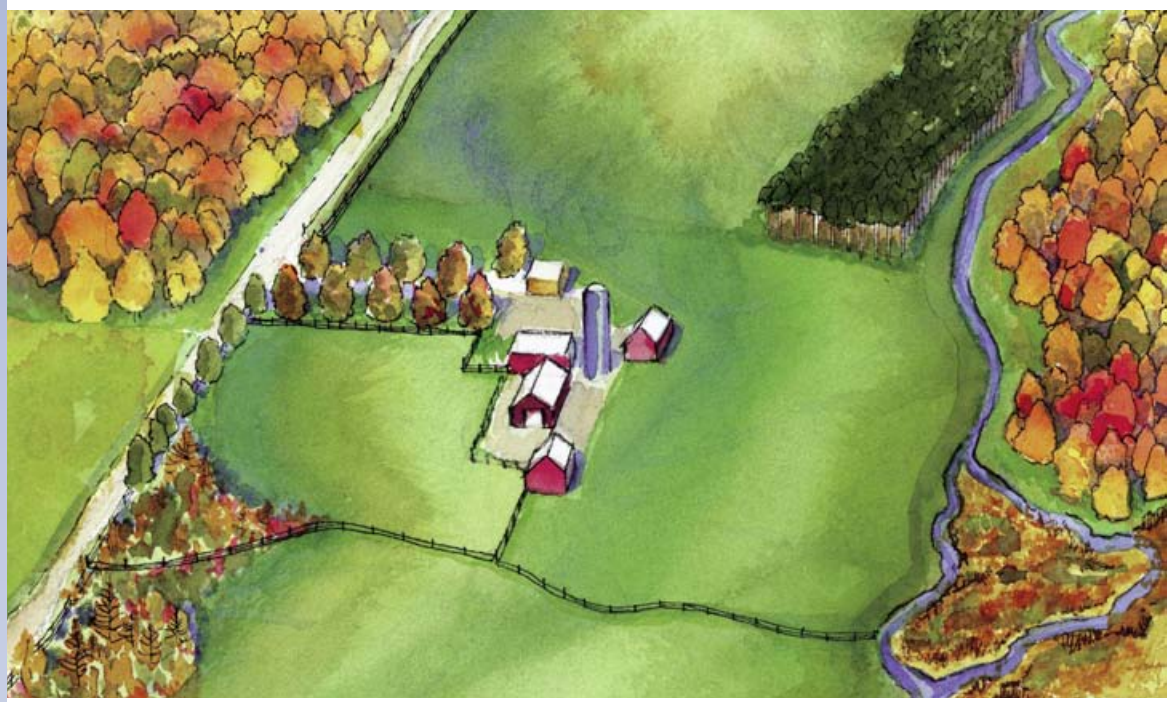
Planning your woodlot's management can be a process of discovery. This chapter leads you through six steps that will build your knowledge of what's on your property and help you develop goals and choose options to meet them.

Knowing what you and your family want from your woodlands and other natural areas will set your plan's direction and purpose.

Steeply sloping and stony lands – especially adjacent to woodlots – offer opportunities for *afforestation* (putting tree cover on old farmland) and other agroforestry practices.

Worksheet #23 in the Canada–Ontario Environmental Farm Plan's *Workbook* promotes sustainable forest management while paying close attention to environmental benefits such as wildlife habitat. In the worksheet, management practices and resource conditions are rated from 4 (Best) to 1, according to a suite of standards agreed to by farmers, foresters and wildlife habitat specialists. To be considered Best, woodland management must include:

- ▶ **a management plan**
- ▶ **planning and harvest assistance from a professional forester**
- ▶ **due regard for environmental concerns (e.g., habitat, water quality) together with long-term business goals.**



Planning can be simple and straightforward. For this property, the plan will concentrate on the management of, and product development from, existing woodlots.

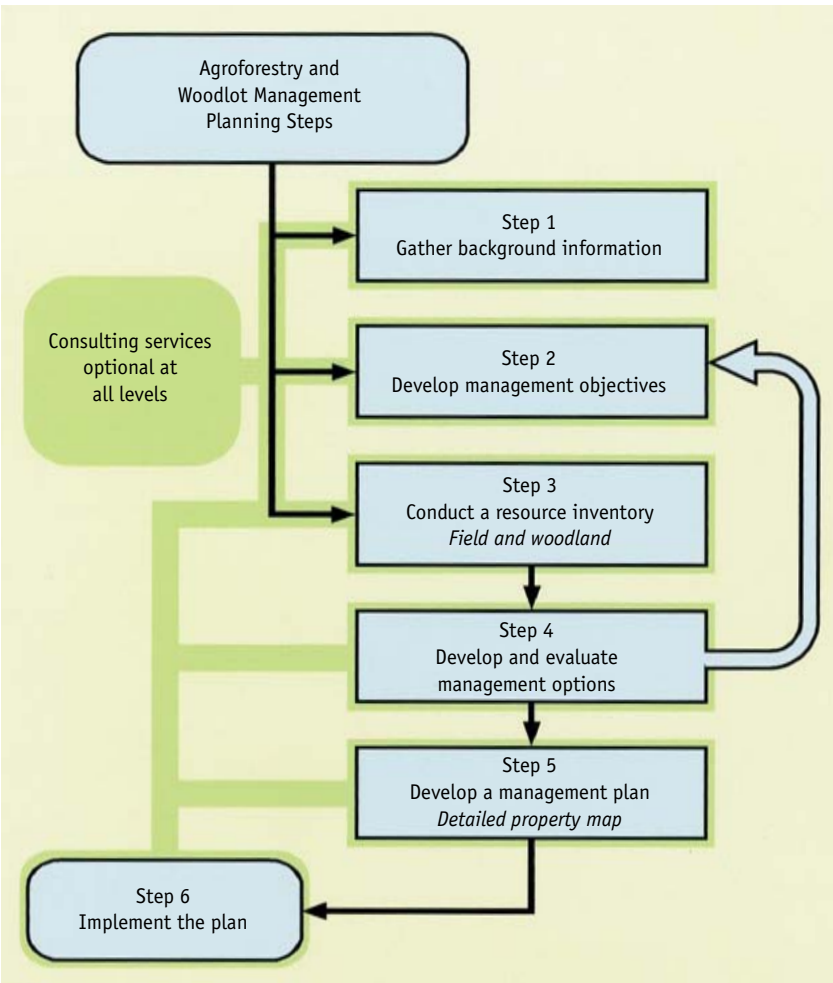
If you need additional help, experienced consultants are available in most areas. Consultants can help you with:

- **developing the plan**
- **determining your objectives**
- **determining what should be done in your forest**
  - ***tree marking,* harvesting, pruning, etc.**
  - **selling your standing timber**
  - **ensuring that your forest is being appropriately managed.**

6 STEPS TO A PLAN

Management planning starts with creating a vision for your property, an idea of what you would like to do over the next few decades. Planning can be looked at as a number of steps. Each step brings you closer to benefiting from the potential of your property.

The following flow chart lists some of the more common steps in the planning process.



For more help with planning, see *A Guide to Stewardship Planning for Natural Areas,* 2nd ed., 2006. It is available from the Ontario Ministry of Natural Resources.

STEP 1. GATHER BACKGROUND INFORMATION

- Learn from others. Talk to neighbours who have harvested, local members of the Ontario Woodlot Association, the Ministry of Natural Resources forest staff, the Ministry of Agriculture, Food and Rural Affairs agroforestry and other specialists, local stewardship coordinators and forestry consultants.
- Gather information from websites and forest management publications.
- Get a sense for the value of woodland planning: do you need a simple short-term prescription or a long-term plan?
- Then get ready. Get information on your property such as:

maps

▷ township map and topographic maps
▷ aerial photos (at a scale of 1:10,000)
▷ forest stand map
▷ soil map
▷ map with legal definitions of property boundaries

forest and ecological information

▷ local woodlot history (was it grazed? harvested?)
▷ wildlife information
▷ watershed information (wetlands, stream, etc.)
▷ local species composition, general ages of local woodlands, recent harvest volumes.

A management plan is a document that maps out a way of achieving your objectives.

Hiring a qualified forestry consultant to help you through the planning process can be money well spent. A consultant can assist you with all aspects of management, from developing your objectives to selling your standing timber. Consultants can also help you maximize your return and ensure that your management actions are appropriate.

STEP 2. DEVELOP MANAGEMENT OBJECTIVES

Developing realistic and appropriate management objectives for your property is an important step in the planning process.

When developing objectives, ask yourself:

- ▶ what do I want my forest to be like in 10 or 20 years?
- ▶ what do I need to do now to start working toward this vision?
- ▶ what am I capable of – time, equipment, financial resources?
- ▶ what type of help will I need along the way?

Objectives are either short-term or long-term in scope. Here are some examples of both types.

Short-term

Over the next 5 years, I plan to:
- ▶ thin my Red Pine plantation
- ▶ plant 500 trees each spring adjacent to my Pine plantation
- ▶ tap 100 Maples each year.

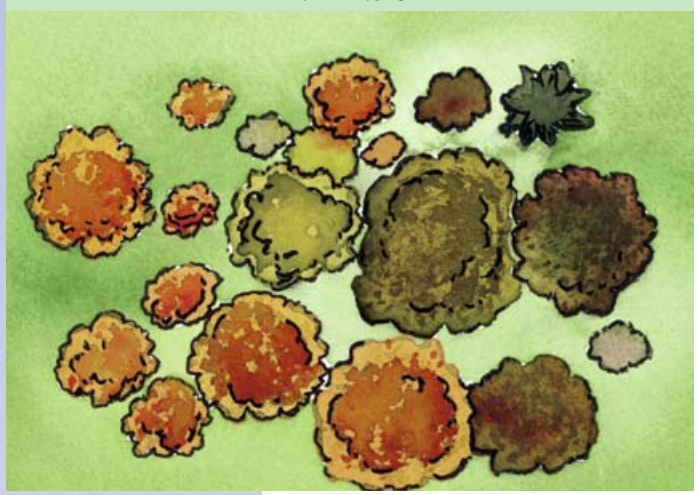
Long-term

Over the next 20 years I plan to:
- ▶ promote hardwood regeneration in my Red Pine plantation
- ▶ connect two woodlots through yearly planting
- ▶ supplement my annual income with maple syrup sales.

Create small canopy gaps to encourage tolerant species of trees. Medium gaps encourage mid-tolerant species. Large openings favour intolerant species.

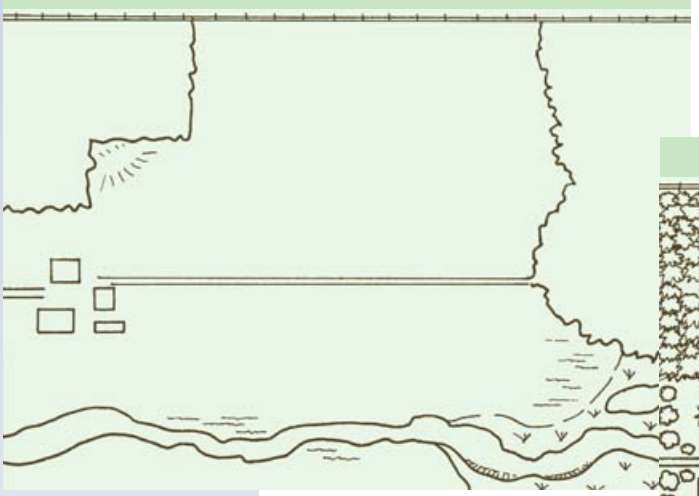
The illustration on the left shows what occurs before the crop trees (remaining trees) have been "released." The crop trees on the right are the ones with dominant crowns. The only trees removed were those whose crowns in the canopy touched the crowns of crop trees. You need to leave some crop trees to grow to maintain the best stocking level in the stand, and to provide new crop trees in the future.

PRE-HARVEST



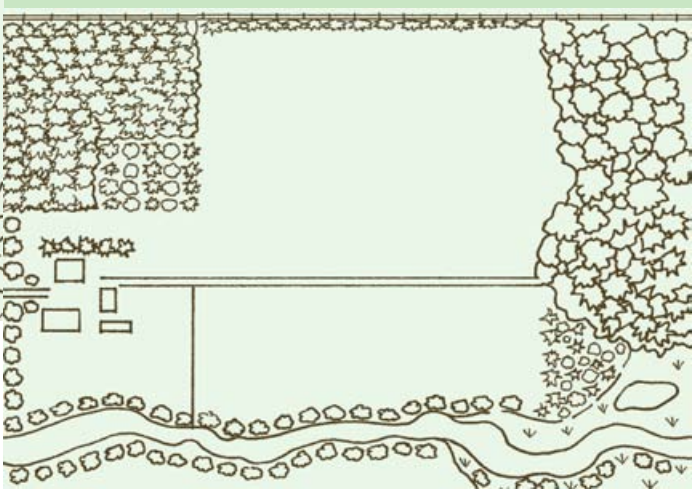
POST-HARVEST

BEFORE

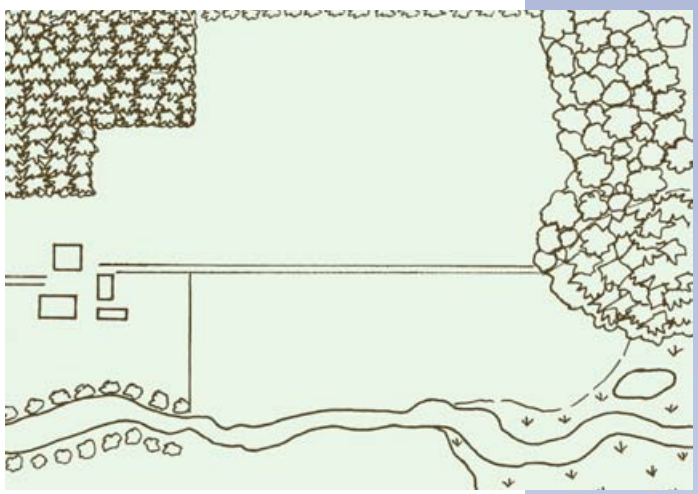


Your property is part of the bigger landscape. Your planned efforts will provide the maximum benefit to both you and to the surrounding environment. Planting trees or leaving an area to regenerate naturally can connect woodlots, increase forest size, and buffer water features.

AFTER



Altering wetland features can have a disastrous impact downstream. This example shows flooding resulting from extensive clearcutting of Soft Maple on a lowland site.



Sketching a map is an important step in the inventory. Mark on your map any features that may impact your farming and agroforestry operation.

STEP 3. CONDUCT A RESOURCE INVENTORY

Conduct a resource inventory of your property to:

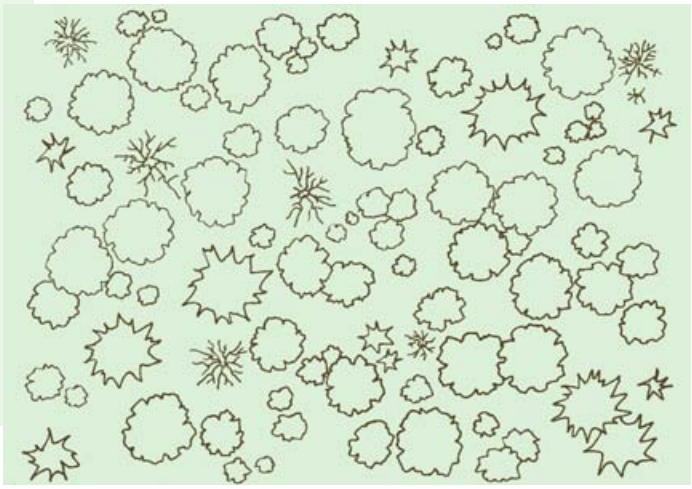
- ▶ provide a snapshot of your agroforestry assets – soils, forests, other natural features
- ▶ state the condition and value of your woodland
- ▶ delineate distinct management areas or units on property.

Use a map to sketch potential agroforestry activities. Where would you like to plant the windbreak or wetland buffer? Where will any new roads or trails be located? What areas are you planning on leaving as they are?

A woodland inventory will help answer these questions:

- ▶ what do I have?
- ▶ how can I best realize my objectives for the woodlot?
- ▶ are my objectives realistic?
- ▶ should it be thinned? If so, by how much?
- ▶ which trees should be removed?
- ▶ what is their approximate value?

The inventory provides essential information regarding the quantity and quality of woodland assets.



Selling your timber by the woodlot would be like selling your cattle by the paddock. Some landowners have sold their timber for the first offer that came along. One Ontario landowner sold approximately $80,000 worth of wood for $5,000. An inventory would have provided useful information on what was actually being sold, and helped the landowner get a fair price.

INVENTORY FEATURES

FEATURE	DETAILS
DENSITY – # OF TREES	• expressed in trees per acre (or hectare) and/or *basal area*
SPECIES COMPOSITION	• what type of forest it is (a Maple stand, Pine stand, etc.) • species mix • natural arrangement – manageable compartments or stands of similar species and sizes
DIAMETER CLASS DISTRIBUTION	• related to species, site, density and age • provides an estimate of value broken into size categories or classes • helps tell you if your forest is overstocked or understocked (too few trees)
QUALITY	• based on tree health and future potential • two main classifications for tree stock: ○ Acceptable Growing Stock (*AGS*) trees that are healthy and viable ○ Unacceptable Growing Stock (*UGS*) trees that will decline before the next harvest or show poor form
FOREST SITE CONDITIONS	• factors that may influence management decisions • soil depth limitations – often mean slow stand growth • moisture limitations (too little or too much) – influence species and growth potential for regeneration • competing vegetation

STEP 4. DEVELOP AND EVALUATE MANAGEMENT OPTIONS

Armed with the inventory and the background information you've collected, you can now develop and assess management options. (Note: a forestry consultant would be helpful during this process.) Reflect on your values, goals and objectives when assessing options.

Some of the considerations:

- **Assess and select a silvicultural or management system.** For example, many farm woodlots are in the tolerant hardwoods group and are most suited to the selection system of management (see BMPs for Woodlands). However, some may be more suited to a shelterwood system if there is a goal to increase the composition of shade intolerants in the stand.
- **Identify business goals.** Are you looking for short-term income or long-term investment? Do you burn fuelwood or use wood products in-kind? Are you planning to do this work yourself?
- **Develop several harvest prescriptions,** based on the silvicultural system selected. Drafting ideas for species, sizes and quality classes of trees to be harvested will help you envision the after-harvest look and impacts on the residual trees.
- **Protect the environment.** This is the time to assess the impact of management on wildlife habitat goals, recreational needs and the protection of fragile and natural areas in the woodland (e.g., streams, wetlands).
- **Look at agroforestry options.** Are there marginal or fragile lands on your property? Would growing trees on these lands be an option? Could you connect natural areas with windbreaks or treed buffer strips?

Windbreaks and shelterbelts connect natural areas such as woodlots and wetlands.

In this step, forest conditions are assessed and a suitable silvicultural system is selected.

STEP 5. DEVELOP A MANAGEMENT PLAN

The management plan can be a formal document or an informal file, depending on the needs and intent of the woodland owner. The plan usually consists of a written section and maps. The written portion includes:

- description of goals and objectives
- description of woodlot (woodlot inventory)
- description of long and short term goals
- management plans and prescriptions (actions to achieve goals and objectives)
- records for income, expenses, harvest volumes, cost of *reforestation* and other information.

TREES AND TAXES

There are tax implications of selling woodlot-related products. Canada Revenue Agency (CRA) tax bulletin IT 373R2 (Consolidated) addresses:

- issues concerning the determination of taxable income, for income tax purposes, of owners and operators of woodlots, including woodlots operated as farms
- the definition of a woodlot – treed land held primarily as a source of fuel, posts, logs or trees, whether the trees are grown with or without human intervention
- how to determine if your woodlot is a commercial woodlot
- the need for management planning
- the definition of the phrase "reasonable expectation of profit"

STEP 6. IMPLEMENT YOUR PLAN

A forestry consultant can also be hired to supervise harvest operations.

When implementing your plan,

- follow the management prescription – include environmental protection requirements
- have the trees marked by a qualified tree marker
- put the marked trees up for tender to a group of local reputable loggers
- develop a contract with the logger of your choice – not the one from the logger
- harvest the marked trees using a qualified logger (refer to section on BMPs for Harvest, pg. 138)
- conduct a post-harvest assessment.

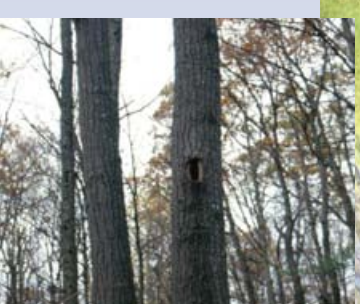
SUITABILITY OF WOODLAND TYPES FOR PRODUCTS AND OTHER BENEFITS

WOODLAND TYPE	TIMBER PRODUCTS	FUELWOOD PRODUCTS	SPECIALTY FOREST	MAPLE SYRUP PRODUCTS	ENVIRON-MENTAL	MULTIPLE VALUES PROTECTION	WILDLIFE HABITAT
TOLERANT HARDWOODS	VS	VS	S	VS	S	S	S
UPLAND MID-TOLERANTS	VS	VS	VS		S	S	S
UPLAND MIXEDWOODS	VS	S	S		S	VS	VS
EARLY SUCCESSIONAL	S	S	S		S	S	VS
LOWLAND HARDWOODS	S	S	S		VS	VS	S
LOWLAND MIXEDWOODS	S	S			VS	VS	VS
WHITE CEDAR	S		VS		VS	S	VS
RIPARIAN FORESTS	VS	VS		S	VS	VS	VS
WETLANDS – SWAMPS	S	S	S		VS	VS	VS
TREED FENCEROWS	S	VS	S	VS	VS	VS	S
SHELTERBELTS AND WINDBREAKS	S	S			VS	S	S
CONIFER PLANTATIONS	VS		S		S		
MIXEDWOOD PLANTATIONS	VS	S			S	S	S
HARDWOOD PLANTATIONS	VS	VS	VS			S	
SUGAR MAPLE PLANTATIONS	S	S	S	VS	S		

VS = Very suitable **S** = Suitable **Blank** = Unsuitable

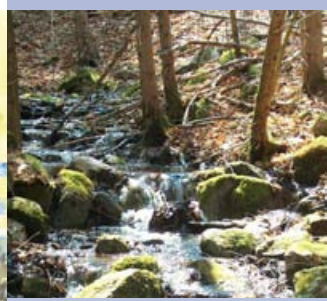
Maple products.

Timber products.



Wildlife habitat.

Established woodlands and opportunities for new plantings can be found on most rural properties. Each forest area offers a unique set of values and products.



Environmental protection.

Specialty products.

Check the table on page 53 to locate information on woodland types and products that interest you.

BMPs FOR WOODLOTS

WOODLOT PRODUCTS AND ECOLOGICAL VALUES

Woodlots can be managed for multiple values such as timber, fuelwood, specialty forest products, recreation and wildlife. Although some of these values may seem conflicting, in most cases it is possible to realize more than one benefit from your forest. See the photos on this page for some examples of the multiple benefits a well-managed woodlot can yield.

Recreational use along woodlot access roads and trails.

Forestry farming products.

A diversity of plants and animals.

Timber sales.

Fuelwood from a sugar bush.

Cedar pickets from swamp forests that retain wetland values.

Remember too that these areas have a very important ecological function. Ontario was once covered in woodlands, wetlands and other natural areas. Today, a rural community with a good proportion of natural areas (i.e., 20% forest cover) and farmland is more resilient to water and wind erosion and less prone to flooding or droughts. Additional functions from which we benefit are listed in the following chart.

BENEFITS OF WOODLOTS TO THE LANDOWNER	
DIRECT BENEFIT	**MARKETABLE PRODUCTS**
WOOD PRODUCTS FEED PROCESSING	• Timber from woodlots and plantations • Veneer logs from timber harvests • Fuelwood from woodlots • Pulp from woodlots and plantation thinnings • Modified feedstuffs to improve palatability and availability of nutrients
NON-WOOD PRODUCTS	• Maple syrup and other maple products • Cedar boughs for ornamental purposes • Ground Hemlock for medicinal purposes • Mushrooms for culinary markets • Forest herbs for alternative medicine
ON-FARM WOOD PRODUCTS	• Fuelwood to offset energy costs • Fencing materials • Building materials for framing, siding, pens, wagons, tools, home furniture-making
INDIRECT BENEFIT	**THE DETAILS**
INSURANCE	• Use timber sales from woodlots and plantations as insurance against low farm commodity prices
PROPERTY VALUE	• Include timber when determining the value of your property for real estate or for equity purposes • Remember that woodlands are an asset – beyond timber value – if you're considering the non-farm real estate market
LABOUR USE	• Use on-farm labour during off-seasons or when conditions are unsuitable for fieldwork to produce maple syrup, fuelwood, fencing and building materials
LAND USE	• Create or maintain woodlots and plantations for wise land use – especially for marginal and fragile lands on your property

Fuelwood is often a secondary product from timber harvest operations. It can also be a major source of revenue from degraded stands.

Maple products are derived from tolerant hardwood stands dominated by Sugar Maple.

Timber products include veneer and *sawlogs*.

BENEFITS OF WOODLOTS TO THE COMMUNITY	
INDIRECT BENEFIT	**THE DETAILS**
SOIL	• Tree canopies and understory vegetation intercept rainfall and protect soil from storm events • Forest soils are higher in organic matter and have erosion-resistant soil structure • Tree roots anchor soil and keep it in its place
WATERSHED	• Woodland soils hold onto more water than cropland • Riparian woodlands can reduce the impact of flooding
GROUNDWATER	• Woodlands protect sensitive groundwater areas such as recharge and discharge zones • Woodlands help keep surface water tables at normal depths
CLIMATE CHANGE	• Woodlots and plantations trap or "sequester" carbon dioxide from the atmosphere and produce oxygen, thereby reducing the impact of climate change • Riparian and wetland woodlands take up nitrate-nitrogen moving from shallow aquifers, reducing the risk of generating nitrous oxide (a greenhouse gas)
WILDLIFE HABITAT	• Wildlife require food, water, cover and space – many woodlands provide all four requirements for some species • Woodlands are particularly important for fauna that are woodland-dependent
FISH HABITAT	• Riparian woodlands protect aquatic habitats from land-based disturbances • These woodlands also provide base-flow for habitat and shade to keep stream temperatures low
HUNTING AND FISHING	• Farm woodlands, especially those with diverse well-connected components, make ideal spots for hunting and fishing ○ some landowners have found it advantageous to lease their natural areas to responsible game and rod clubs
OTHER RECREATIONAL ACTIVITIES	• Woodlands make ideal recreational environments for hiking, nature-appreciation, snowmobiling and other trail uses
AESTHETIC	• Rural tourism benefits from aesthetically desirable landscapes: a mix of field, forest and streams is considered prime rural scenery for most tourists

"Riparian" forests help protect water quality and habitat.

Autumn leaves in full colour are beautiful to behold, and can be an important tourism draw.

Many landowners manage their stands for wildlife, such as this Saw-whet Owl, as well as for other benefits.

MANAGEMENT PRINCIPLES AND SILVICULTURAL SYSTEMS

MANAGEMENT PRINCIPLES

A common management goal is to develop a healthy and productive woodland from which marketable products can be derived, while conserving other woodland values.

Here are 10 principles to consider.

1. **Trees are a crop – they mature and quality declines over a long period.**
2. **Trees will regenerate themselves – it's more difficult if site conditions and past management are unfavourable.**
3. **Each tree species has special needs – light, space, nutrients, water, seedbed requirements.**
4. **Each tree has value – some are more commercially valuable than others.**
5. **Spacing should be controlled: tight when young, freedom as they mature – space increases diameter growth, and volume growth is exponential to diameter growth.**
6. **Thinning young stands increases space for growth of crop trees.**
7. **Removing poor producers and poor quality trees gives more space to trees with potential.**
8. **Woodlands need protection.**
9. **Woodlands are ecosystems – respect all values and uses.**
10. **Woodlands should be managed according to a suitable silvicultural system for the local area.**

SILVICULTURAL SYSTEMS

A silvicultural system is a planned program or system of management treatments scheduled throughout the life of the stand. Harvesting, thinning, pruning and planting activities can all be considered silvicultural treatments that may be used to influence the development of a forest stand over time.

The appropriate system for your forest depends on two main factors:

your management objectives for the stand

► what do you want to get out of the stand now, as well as in the short and long term?

the appropriate silvicultural and ecological choices for the existing forest

► the options you have for management are determined by the type of:

▷ forest currently growing in the overstory – different types of forests require different methods of management

▷ regeneration coming up in the understory – trees in the understory will eventually grow and become the future overstory

► every stand will have a number of alternatives for its future management direction

▷ your choice of treatments should in part be based on the capability of the site – is it a good site for the type of forest growing on it, or in the understory?

It is relatively easy to predict the short- and mid-term changes to a stand that will result from management actions.

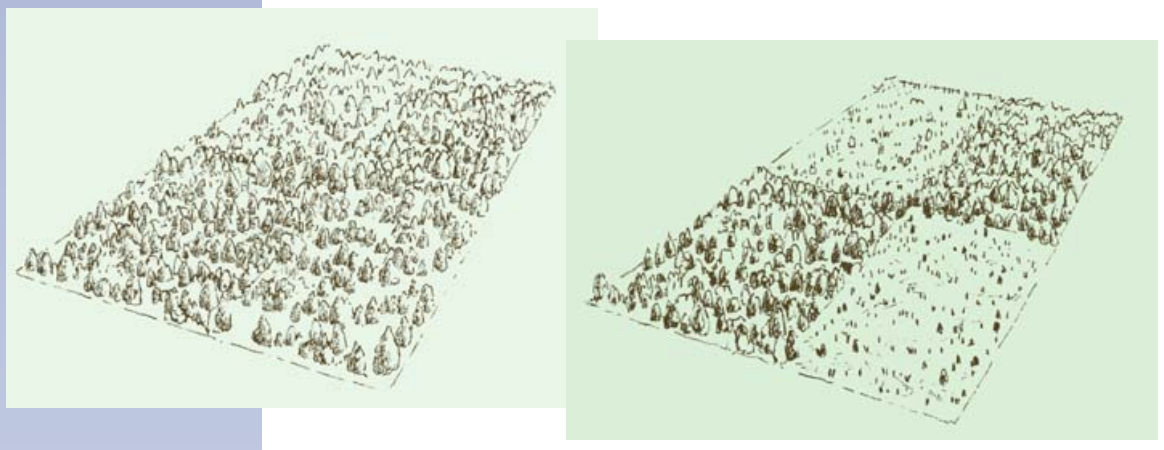
It is important to find a balance between these two factors. Many of your management objectives will coincide with the silvicultural and ecological potential for the stand, but others may not.

Management systems best suited to your woodlot should be discussed with a forestry professional. The following chart introduces three types of management systems that may apply to your woodlot.

Selection is an *uneven-aged* silvicultural system, best suited for shade-tolerant hardwood woodlots. It involves the harvest of relatively few trees to promote the growth of higher value trees and regeneration of seedlings.

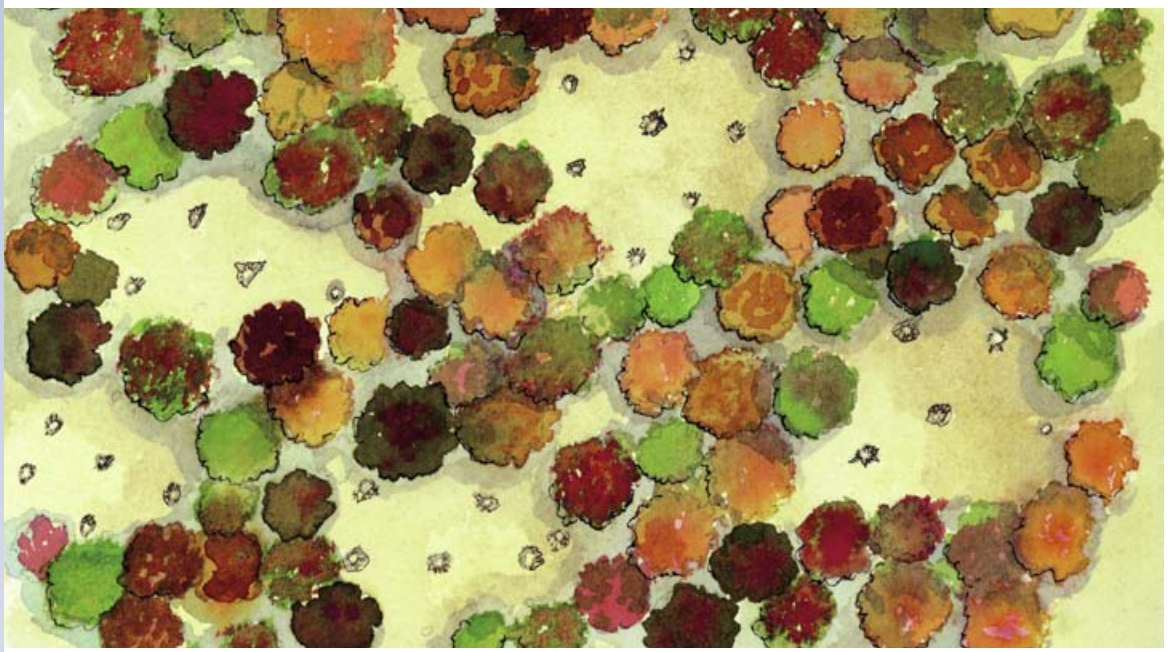
MANAGEMENT SYSTEM	DESCRIPTION	USAGE	FOREST TYPE
SELECTION (individual tree, group)	• harvesting of individual trees or small groups of trees • most of the trees and a variety of *age classes* (uneven-aged) left to grow and regenerate naturally	• promoting high-value hardwoods • managing sugar bush • enhancing environmental values	• shade-tolerant species – Sugar Maple, Beech • shade-tolerant conifers – Hemlock
SHELTERWOOD	• gradual removal of the entire stand in a series of two or more partial cuts • natural regeneration encouraged in the shelter and shade of the remaining trees	• growing high-value hardwoods and conifers • renewing degraded stands	• mid-tolerant hardwoods – Red Oak, White Ash, Hickory, Yellow Birch, Basswood, Red Maple • White Pine
CLEARCUT, STRIP CUT, PATCH CUT	• removal of the entire overstory in one cut • regenerate poor quality stands – plant with seedlings or leave to regenerate naturally • most clearcuts are modified clearcut for a specific purpose (e.g., patch cut in Cedar)	• regenerating shade-intolerant species – Poplar, Birch • regenerating species that can reproduce vegetatively	• early successional, shade-intolerant species – Poplar Birch, Cedar

In the shelterwood system, the overstory is removed in a series of three or four harvests. The regeneration of mid-tolerant trees such as Red and White Pine as well as Oak, Ash and Hickory is encouraged with this system.

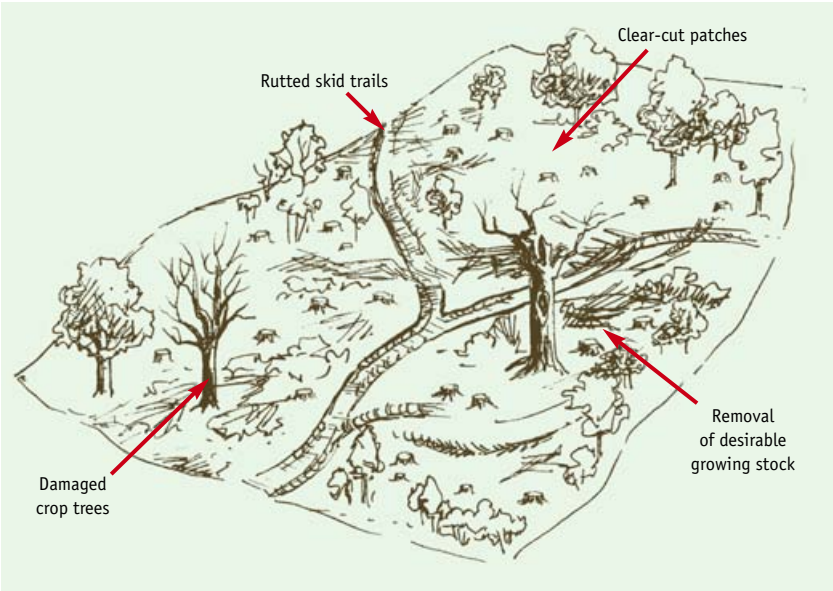


The patch-cut system is a form of clearcut that has been successfully applied in renewing Poplar stands.

Some forest managers and landowners create small openings within a stand. These openings are usually as wide as the stand is tall and help promote species diversity within the stand. Group selection within stands of shade-tolerant hardwoods promotes the establishment of mid-tolerant hardwoods like Oak, Basswood and Yellow Birch.



Poor logging practices can damage the site and residual growing stock.



Poor management practices can ruin a woodlot. This illustration shows a woodlot where all the best trees were removed from the stand, leaving the poor quality ones to grow as the future forest. This woodlot will not yield any more timber – at least for the next 50 years or so!

WOODLOT STRUCTURAL FEATURES

If the goal of woodlot management is to obtain a full stand of valuable trees in a shorter period of time, then the ideal woodlot would have a diverse range of tree ages and sizes with proper spacing between crop trees to maximize growth.

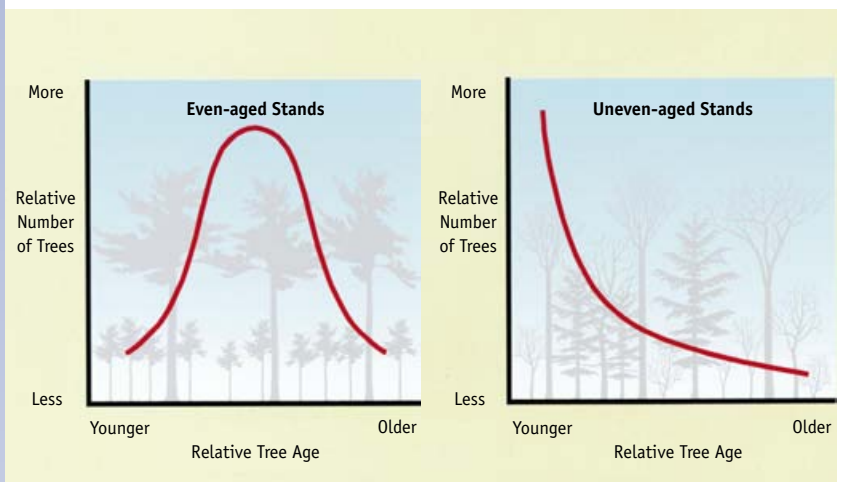
In truth, there are few woodlots that approximate this condition. Many are overmature with no regeneration or too tightly spaced to allow for crop tree growth. Woodlot planning and suitable forest management BMPs are essential to shaping the stand to this ideal.

There are two key conditions considered during the inventory stage – beyond forest cover type and past history – that directly affect the suitability of a silvicultural system and the BMPs to make the system work:

- ▶ stand age and size class distribution
- ▶ density.

The 1998 ice storm in eastern Ontario caused widespread damage to forests throughout the affected area. Although it is impossible to account for this type of disaster in a management plan, woodlots that were well-managed before the ice storm tended to fare better than those that weren't.

STAND AGE AND SIZE CLASS DISTRIBUTION



In even-aged stands, most of the trees in the woodlot are in the same age range. Uneven-aged stands have trees from all age classes:

- **most of the trees are younger (seedling and sapling)**
- **a moderate number are the polewood-size class, and**
- **a few are mature and over-mature trees.**

Even-aged? Uneven-aged? What do these two terms really mean?

Most of the trees in even-aged stands tend to be about the same age. If you were to plot them on a graph, it would look something like the one shown on the left above: a bell-shaped curve that peaks around the average age of the stand. Uneven-aged stands, on the other hand, tend to have a completely different distribution when plotted on the same graph. In this type of stand, there are more younger trees than there are older ones. In this stand, only a few of the younger trees will live to maturity.

Which is better?

For the tolerant hardwood working group, uneven-aged management is usually recommended, although there are circumstances where even-aged management would be appropriate.

Uneven-aged stands tend to:

▶ provide a constant and more regular supply of forest products
▶ provide a more stable supply of habitat features.

Even-aged stands change considerably throughout the life of the stand (young to mature) and don't usually yield timber products until the stand has matured. This can mean a span of 50 years or more between harvests. Even-aged management is more suited to mid-tolerant and intolerant species.

Can even-aged tolerant hardwood stands be converted to an uneven-aged structure?

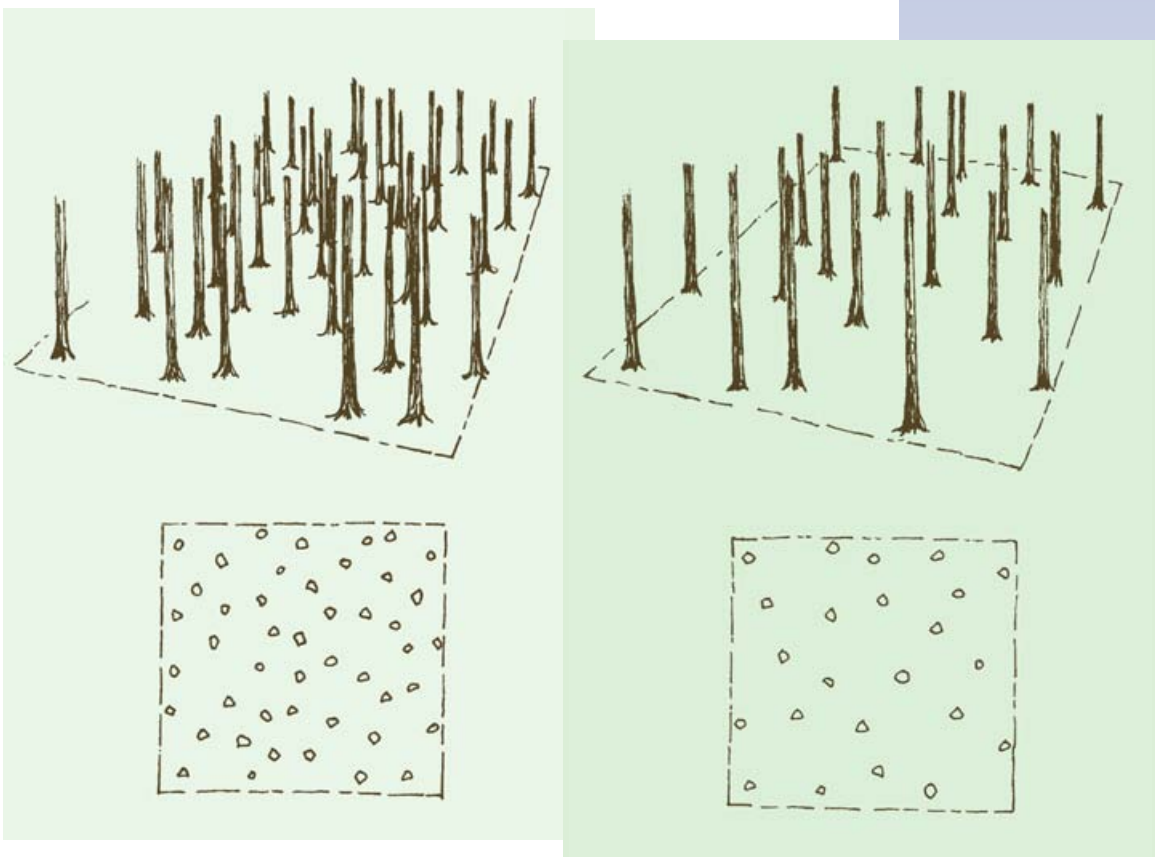
The answer to this question is yes, but it may take many years. If your stand is even-aged, using the selection system to promote regeneration will work. However, this will often result in a woodlot made up of two ages (old and young) because a second commercial harvest will not generally be warranted for many years.

One way of converting an even-aged forest to an uneven-aged one is to reduce harvest intensity, but increase the frequency of harvests. Instead of one harvest every 15 to 30 years (depending on site), break the harvest up and take fewer trees but cut every 5 to 10 years. Landowners completing the work themselves often prefer this approach.

There are other methods of achieving this goal and it is recommended that you discuss your circumstances with a forester before harvesting.

STAND DENSITY (EXPRESSED AS BASAL AREA)

Basal area is used as a guide to estimate the density of a woodlot and to plan woodlot harvests. In this sketch, the stand on the left is overstocked, at BA > 32 m^2/ha (140 ft^2/ac). The illustration on the right shows the same stand after thinning to a residual basal area of 20 m^2/ha (88 ft^2/ac) – which is often preferred for best-diameter growth.



The cross-sectional area of trees can be determined with the following formula: 3.14 x ($^1/_2$ diameter x $^1/_2$ diameter).

For example, with a diameter of 20 cm at 1.3 metres:
3.14 x ($^1/_2$ 20 cm x $^1/_2$ 20 cm)
= 3.14 (10 cm x 10 cm)
= 3.14 (100 cm^2)
= 314 cm^2

BA is the sum of the cross-sectional areas on a unit area basis (per hectare or per acre).

What is a "basal area"?

The concept of basal area (BA) is a very important one in agroforestry. Basal area can be determined by measuring the individual diameters of the trees in the stand and using this information to calculate the total cross-sectional area of the trees 1.3 metres (4.5 ft) aboveground.

The measurement is taken at 1.3 metres aboveground because it is high enough to avoid stump flare near the ground, a convenient height for measurement, and an accepted industry standard.

The total cross-sectional area of all trees is then calculated and expressed on a unit area basis (BA per hectare or BA per acre).

A prism can also be used to determine basal area. A tree is counted "in" if the stem seen through the prism overlaps the stem seen through the naked eye. A stem is counted out if it doesn't overlap the stem as seen through the naked eye. The stand's BA is the total of all the "in" trees counted in a circular plot, multiplied by the BA factor of the prism (usually 2). For an example of some illustrations, please see pg. 115.

How is the basal area concept put to use?

Because basal area is a measure based on a unit of land, we can compare individual basal areas to each other or to a known standard to see how our forest compares.

For example: If the basal area of a Maple forest was estimated to be 32 m^2 per hectare (140 ft^2/ac), it would help to form a general idea of what the forest is like even if you have never been there to see it. Forest science tells us that a basal area of around 20 m^2 per hectare (88 ft^2/ac) is ideal for optimum growth. Because this stand is at 32 m^2/ha, you would probably be right if you guessed that it was fairly dense and perhaps there were too many trees.

What is missing here is any reference to tree size. Basal area is a good indication of stocking. A BA of 32 m^2/ha is overstocked regardless of tree diameter, but is it made up of many small trees all crowded together, or is it a few very large trees scattered about as if in a park setting? Or is it a mix of the two? Basal area is only one part of the picture. You need to know the size class distribution of the trees as well.

Bear in mind that BA is used along with other considerations such as the physical condition of the trees, their physiological age, and their crown position.

GENERAL BMPs FOR WOODLOTS

BMPs FOR WOODLOT PROTECTION

Maintaining a healthy woodlot is essential to achieve your long-term objectives. Taking the following steps can go a long way to reducing some predictable threats to woodlot health.

Fire

Forest fires in southern Ontario woodlots are rare. Conifer plantations on dry sites are at the greatest risk, e.g., Red Pine on coarse sandy sites.

- ✔ Maintain a ploughed/disked buffer around plantations to keep grass fires from spreading. Width: 4.8 m (16 ft) or 2 cultivation widths.
- ✔ Maintain fences and limit access by unwanted users.
- ✔ Keep fire-fighting equipment on site and in your vehicle.

Maintained firebreaks can lower the risk of grass fires spreading to woodlots and plantations.

Insect and disease damage

- ✔ Monitor forest health on a regular basis. Scout three or four times annually to check for degradation/unauthorized use, forest pests or disease, and the presence of invasive species. Spot problems early while they can be controlled. Seek help from provincial forestry or agroforestry specialists or forestry consultants when a problem is suspected.
- ✔ Learn to identify some of the more common insect pests like Gypsy Moth, Forest Tent Caterpillar, and Pine Sawfly.
- ✔ Learn to identify established invasive pests like Asian Longhorn Beetle and Emerald Ash Borer. Report any suspected sightings to the Canadian Food Inspection Agency (check the blue pages of your phone book for contact information).
- ✔ Learn about some of the more common disease problems facing southern Ontario's woodlots. Dutch Elm Disease, Chestnut Blight and Butternut Canker have already severely impacted Ontario's forests. Disease such as Beech Bark Disease and Oak Wilt are spreading throughout North America.

Problems from improper harvesting practices

- ✔ Do not over-harvest, high-grade cut or diameter-limit cut your woodlot.
- ✔ Poor harvesting practices that damage residual quality trees can dramatically reduce the future potential of your woodlot to produce high-value forest products. Minimize cutting, felling and skidding damage to remaining trees.

Poor harvesting practices can damage a tree, lowering its value as a future crop tree.

It is possible to introduce new tree species to your woodlot. Shumard Oak is listed as a vulnerable species in Ontario and like other Carolinian species can be found growing with a number of different species. If you live in an area where Shumard Oak can grow, you may be able to establish it in your woodlot.

Invasive plant species

✔ Pressure-wash forestry equipment before it's moved from one bush to another to help limit the spread of weed seeds and vegetative material.

✔ Don't dispose of waste plant materials in your woodlot. Prunings, cuttings and seeds may reintroduce the problem.

✔ Maintain natural vegetation along woodlot edges. Dense vegetation along edges reduces the number of weed seeds that can blow into your woodlot.

✔ Don't plant non-native groundcovers (e.g., Periwinkle) in your woodlot.

Nuisance wildlife

Beavers

✔ Monitor wetlands and streams regularly for Beaver activity.

✔ Consider installing a beaver baffler system to help control pond size.

✔ If needed, contact a local trapper (names available from Ontario Ministry of Natural Resources) to help manage Beaver populations.

A beaver baffler similar to the one shown above can help regulate water levels in Beaver-flooded ponds. Because the outlet pipe is set below water level, Beavers have difficulty stopping the flow of water.

Porcupines

✔ Monitor your woodlot regularly for signs of Porcupine activity. Porcupine are most easily seen in leaf-off conditions, when they may be observed feeding on young bark.

✔ If needed, control Porcupine numbers.

BMPs FOR TIMBER PRODUCTION

Generally, forest management for timber production is a manipulation of forest composition and density to maximize growth, quality and return. In a selection system, managing for timber production is a matter of promoting diameter growth by removing low-value, unproductive trees from the stand so that the remaining trees have space to grow faster.

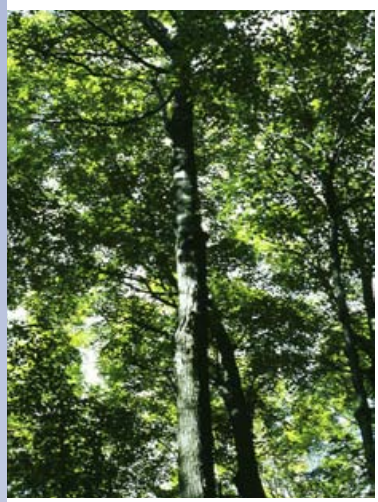
The value of similar quality trees varies considerably across Ontario. The tree on the left was veneer quality at harvest, with a stumpage value of $1,800. On the right, the defected, stunted tree from an unmanaged woodlot was worth $30. Not only was Tree A younger, but it was larger and as a result more valuable, yielding one or two veneer logs, one 3-m (10-ft) sawlog and some fuelwood from the treetop. Tree B hadn't even reached the small sawlog-size class after 75 years. It yielded only firewood.

Tree A.

Tree B.

Follow these best management practices to keep your woodlot healthy before, during and after timber harvest.

BEST MANAGEMENT PRACTICES FOR TIMBER PRODUCTION	CONSIDERATIONS
SELECT CROP TREES WITH CLEAR, STRAIGHT BOLES AND HEALTHY CROWNS	• Crop trees are trees left for future use. • Choose trees with large, well-formed crowns, few defects, and few or no forks in the first half of the trunk.
KEEP LIVESTOCK OUT OF YOUR WOODLOT	• Livestock compact soil around tree roots and also damage exposed roots. Grazing livestock will reduce the quality of stems and their growth rate. • Refer to Environmental Farm Plan Worksheet #23 for more advice on winter access.
HARVEST ON FROZEN GROUND, OR IN AUG.–SEPT. WHEN CONDITIONS ARE DRY	• Logging on wet or moist ground can cause extensive rutting and soil compaction. • Logging from April to July when the bark is loose causes excessive damage to tree stems.
LIMIT FELLING AND SKIDDING DAMAGE	• This means careful layout of logging roads and skid trails, and use of skidding logs in lengths and numbers that will minimize damage to remaining stems.
USE TREE MARKING AND A FOREST MANAGEMENT PRESCRIPTION	• Tree marking ensures that stand quality is retained for future harvests. Forest inventory and a *management prescription* are the guidelines for tree marking, and help ensure that enough trees are left in the stand to maintain optimum growth. Use forestry consultants.
UNDERSTAND WHAT YOU HAVE IN YOUR WOODLOT	• Shop around for markets and prices. Some sawmills distinguish between Grade 1 (high), 2 and 3 (low) sawlogs and pay appropriately. Other buyers do not, and some #2 and #3 logs end up being sold for lower-grade sawlogs or fuelwood and in some areas, pulp. • A forestry consultant can help you determine what you have and help you market it most effectively. Have several loggers provide you with a bid. Get at least three bids and have a consultant monitor the harvest operation on your behalf.
MAINTAIN A DIVERSITY OF TREE SPECIES IN YOUR WOODLOT	• Sugar Maple, Red Oak and White Pine have been and probably always will be valuable species. • Low-value species today may be quite valuable 50–100 years from now when those saplings become sawlogs. • A good forest manager will also retain critical habitat features such as cavity trees and mast trees, regardless of their timber value. • Refer to EFP Worksheet #23 for further advice on habitat planning for your woodlot.



Crop trees should have straight, defect-free trunks. Over time, good forest management practices will remove many of the poorer quality trees from a woodlot. This serves to increase both the proportion of high-quality trees in the woodlot as well as the future return per hectare coming from it.

When planning harvest operations, ensure loggers and consultants work within clearly marked property boundaries.

Take extra precautions when harvesting. Site damage caused by poor logging practices can dramatically reduce any future returns from your woodlot.

An Ontario landowner knew that he had a good quality woodlot at the back of his farm. He just did not know how valuable it was! Over the years he had had several loggers asking him if they could "selectively" log his woodlot. One went so far as to offer him $10,000 for the timber after only a quick walkthrough!

The landowner had heard logging horror stories from some of his neighbours so he decided to do things right. He hired a forestry consultant to help him with his management plan. The consultant inventoried the woodlot and worked with the landowner to decide what should be done based on what he had. After deciding to go ahead with a harvest, the landowner hired the same consultant to mark and tally the woodlot accordingly. The marked trees were then sold to one of three loggers who bid on the harvest.

The logger paid the landowner about $14,000 for the standing timber. The total cost to the landowner for the consultant was $1200. The logger harvested 45,000 *board feet* (bf) of sawlogs, 5,000 bf of veneer and 100 cords of fuelwood.

Although the landowner only made $2,800 more than the first logger had offered, he was happy with the return. He recognized that the woodlot would generate income in future, periodic harvests, and that his woodlot was well-managed. Who knows what would have happened if he had done it differently?

A CASE FOR SUSTAINABLE MANAGEMENT OF A FARM WOODLOT

George and Sandy Barrie farm 250 acres in N. Dumfries Township in Waterloo Region, and produce cash crops, cattle, sawlogs/fuelwood, and maple syrup. They have realized the potential of their forests without compromising the capital because they use sustainable management practices.

PROPERTY – GENERAL

- 187 acres in corn–soybean–wheat
- 48 acres in hardwood woodlot
- 12 acres of fragile soil, reforested
- 24 acres for maple syrup (22 taps/ac); Sugar Maples on pipeline to take advantage of hilly terrain; formerly held paid school tours to demonstrate how syrup is made
- 2.5-ac wetland

SOIL AND SITE FEATURES

- Dumfries loam, somewhat gravelly with some flat terrain with sandy loam to loam soils
- rolling terrain with large central drumlin and some flat terrain

PROPERTY – WOODLOT

- 3 woodlot (W) sites
- forest – 30 acres
  - Sugar Maple 90%; Cherry 5%; minor components of White Ash, Red Oak, Beech and White Pine
- plantation – 12 acres, 3 acres established under Woodlands Improvement Agreement (WIA) with MNR
  - 12,000 Red Pine, 1,000 Black Walnut (1970)
  - area retired under National Soil Conservation Program; planted in 1992: 1300 Black Walnut and 1300 Black Locust
- forest – 17 acres
  - Sugar Maple 84%, Red Maple 10%, minor components of Cherry, Beech, White Pine, Ash, Basswood

LAND USE AND MANAGEMENT HISTORY

- 1968 reforestation under MNR WIA Agreement
- hired professional forestry services to mark trees for harvest
- used logger for large tree-harvest operations
- cut and skid their own fuelwood trees
- produced maple syrup since 1987
- participated in National Soil Conservation Program in 1992
- key opportunities:
  - Red Pine served as nurse crop to 12-ac Black Walnut plantation
  - planned and implemented BMPs
  - use wood products on farm

PRODUCTS

- 22 taps produce 0.8 litre/tap and earn $5 profit/litre, average $88 profit/acre
- 150–200 face cords/year are sold; firewood sales average $26/ac/yr over a 10-yr period – most fuelwood comes from tops of saw logs
- over 10 years, as a result of stand improvement, the yield of maple saw logs rose from 125 bf/tree to 220 bf/tree
- timber harvest yielded timber for barn renovations, and treetops were used for firewood

KEY REFERENCES

- ▶ Terry Schwan, District Forester, MNR Guelph; Steve Bowers, Stewardship Coordinator, Huron County; and Cher Brethour, George Morris Centre, Guelph
- ▶ factsheets, BMP books, EFP Program
- ▶ forest consultant

LANDOWNER TESTIMONIALS

- ▶ "Unlike livestock that must go to market when it's ready no matter the price, trees can be left to grow another year or two if prices aren't favourable."
- ▶ "It's taken a long time to get the woodlot to the point where it's producing at an optimum level."
- ▶ "Trees are a crop. You have to have a long-term outlook, but I'm kind of amazed at the income we're getting from the woodlot. I never suspected there was that much in it."
- ▶ "There are low-input costs for the woodlot, unlike the cash crops. Trees reseed themselves and don't need to be cultivated, fertilized or sprayed with pesticides."
- ▶ "Woodlot product prices tend to remain more stable than for field crops. You know Brazil isn't going to flood the market for firewood. We basically set our price."

WOODLOT AND CROPLAND ECONOMIC ANALYSIS

- ▶ the Barries' operation was one of 8 studies comparing woodlot and crop rotation scenarios
- ▶ total revenues and costs/acre were calculated for each harvest year using using the outcome from forest operations and generic crop enterprise budgets
  - ▶ present value revenue and costs/acre were determined for each crop rotation or forest product at various interest rates – present value costs were subtracted from the revenue to determine the **Net Present Value** per acre (NPV)
  - ▶ crop rotation
    - ▷ 1/3 corn, 1/3 soybean and 1/3 wheat annually and utilizing OMAFRA crop enterprise budgets reflective of industry average costs and returns (variable and fixed)
  - ▶ 1977–2003, $/acre: Woodlot NPV: $6,292. Agriculture NPV: $2,927 = $3,365 more revenue for the wooded portion of the farm than cropland for the 26-year period

For more information about this and related case studies, see www.huronstewardship.on.ca

*RESULTS, WOODLOT & CROPLAND ECONOMIC ANALYSIS COMPARISON, 1997–2003**

- ▶ results showed **$3,365** more revenue for the wooded portion of the farm than cropland for the 26-year period
  - ▷ Woodlot NPV ($/acre) = $6,292
  - ▷ Agriculture NPV ($/acre) = $2,927
- ▶ timber sales – $3,225/acre
- ▶ fuelwood sales – $599/ac
- ▶ maple syrup sales – $2,468/ac

* *Note:* All dollars expressed in 2003 dollars, a 5% compound interest rate and on a per-acre basis.

"Working in the woodlot is not time-critical. Unlike field crops where there is a narrow window for planting or harvest, you can operate in your woodlot from early November to March, whenever you have time."

– George Barrie

"Hire a consultant to help decide which trees should be cut and to get competitive bids. Competitive bids gave us a price range – in one year, the bid range was from $24,600 to $38,570."

– Sandy Barrie

BMPs FOR FUELWOOD PRODUCTION

The income in-kind value of fuelwood cut and burned on farms in Ontario is greater than any other crop harvested and consumed at home. In addition, sales of fuelwood have increased as consumer demand continues to place greater demands on farm woodlands to supply it.

Many timber harvesting operations produce a significant volume of fuelwood as a secondary benefit. Fuelwood harvesting in most woodlots can have a positive impact on woodlot management if carefully planned and properly executed.

Harvesting the low value, low quality trees for sale as fuelwood can:

- ▶ improve growing conditions for the remaining valuable crop trees
- ▶ improve growing conditions for regeneration
- ▶ increase the diversity of tree species in the woodlot
- ▶ improve the health and vigour of the woodlot
- ▶ enhance forest sustainability
- ▶ produce better quality, more valuable timber in the future
- ▶ open a market for low quality wood that may be impossible to sell as sawlogs.

HEATING VALUE OF NATIVE SPECIES OF WOOD

HEAT VALUES	TREE SPECIES	BRITISH THERMAL HEAT UNITS (BTUs)
HIGH HEAT VALUES (26,200,000–32,000,000 btu per air-dried cord)	Rock Elm	32.0
	Ironwood	31.2
	Shagbark Hickory, White Oak	30.6
	Bitternut Hickory, Bur Oak	29.2
	Sugar Maple	29.0
	Beech	27.8
	Red Oak	27.3
	Yellow Birch	26.2
MEDIUM HEAT VALUES (21,700,000–25,000,000 btu per air-dried cord)	White Ash	25.0
	White Elm	24.5
	Red Maple, Tamarack	24.0
	Black Cherry	23.5
	White Birch	23.4
	Red Elm, Green Ash	22.1
	Silver Maple	21.7
LOW HEAT VALUES (15,500,000–19,300,000 btu per air-dried cord)	Largetooth Aspen	18.2
	Hemlock	17.9
	Trembling Aspen	17.7
	Butternut	17.4
	White Pine	17.1
	Basswood	17.0
	White Cedar	16.3
	White Spruce	16.2
	Balsam Fir	15.5

Ironwood offers high heat value.

White Ash has medium heat value.

Basswood has low heat value.

As a general rule, the following trees should be removed from a hardwood woodlot for fuelwood.

Diseased, dead and dying trees – leave an appropriate number of snags and cavity trees.

Trees with weak forks.

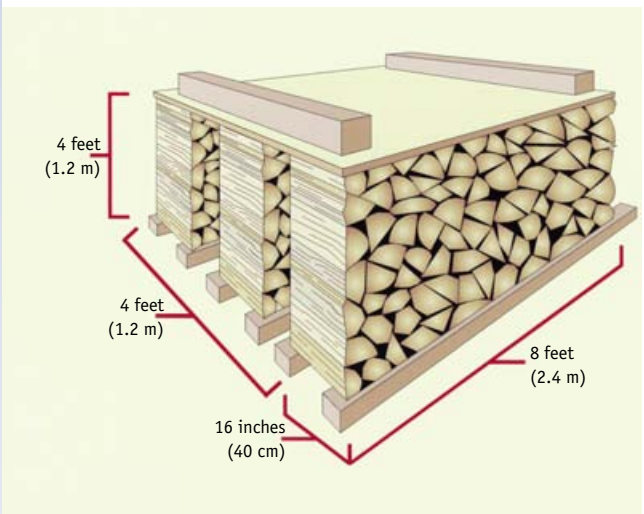
Weed trees such as Ironwood – leave some for edge protection, wildlife such as grouse, and diversity.

Wolf trees (large-crowned, short-boled trees) – consider leaving the occasional wolf tree for wildlife habitat.

Trees that have been overtopped by others with seriously stunted growth.

Crooked or leaning trees.

Firewood should be sold by the standard cord (4 x 4 x 8 ft or 1.2 x 1.2 x 2.4 m) or fraction thereof (such as half cord or quarter cord). Sale of firewood by other units of measurement is illegal.



Wood cut and split during the fall and winter and piled in the open in the spring should be well-seasoned for burning the following winter. Some species such as Hickory and Oak benefit from additional seasoning. Fuelwood should be covered to protect it from the rain while drying.

BMPs FOR SUGAR BUSH MANAGEMENT

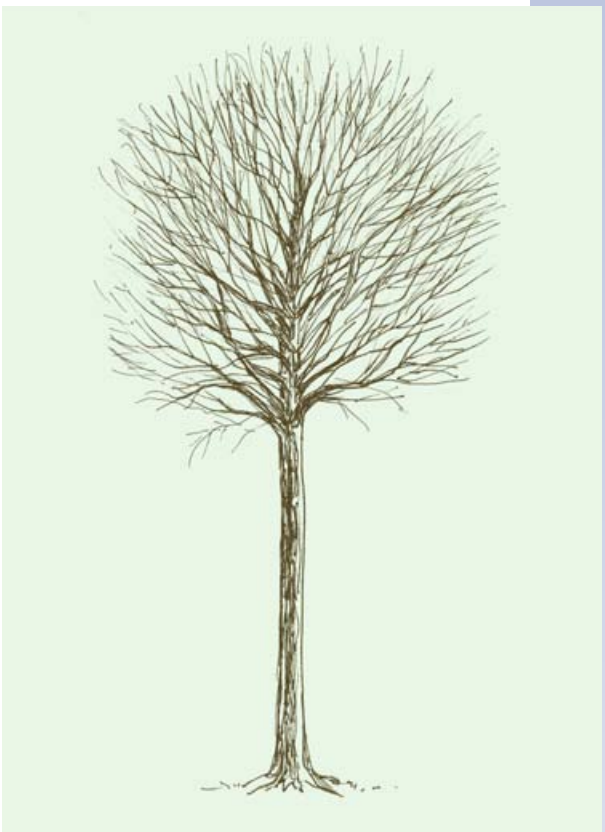
There are two key activities in sugar bush management that contribute to the overall productivity, health, sustainability and profitability of the operation:

- ▶ thinning to develop and improve the sugar bush for maple sap production
- ▶ tapping to maintain tree health and improve sap production.

What makes a tree a "crop tree" depends on the landowner's objective(s).

IDEAL MAPLE SYRUP TREE

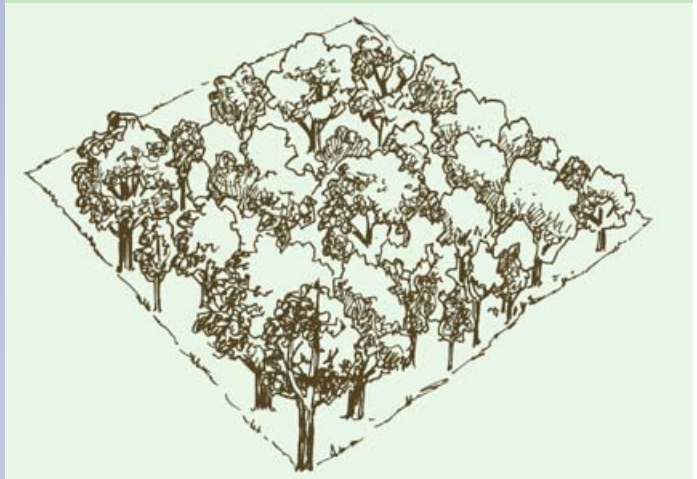
- **Sugar or Black Maple**
- **Larger healthy crown**
- **Trunk shape not as important**
- **Sweeter sap compared to non-crop tree**



IDEAL TIMBER TREE

- **Smaller crown**
- **Long straight trunk with little taper**
- **Trunk free of all defects**
- **Multiple species – not just Maple**

YOUNG SUGAR BUSH

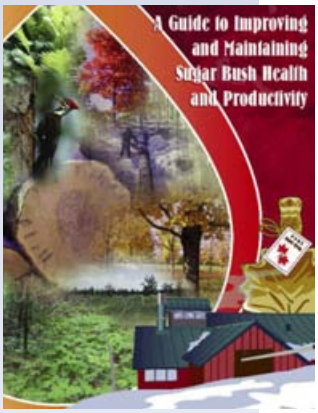


YOUNG SUGAR BUSH AFTER THINNING

TO DEVELOP THE YOUNG SUGAR BUSH IN PREPARATION FOR TAPPING

- **choose approximately 250 crop trees of 15–25 cm DBH per hectare (100 crop trees of 6-10 in. DBH per acre)**
- **try to select one every 6–7.6 m (20–25 ft)**
- **remove neighbouring trees around each crop tree**
- **create openings around the crop trees of 1.8–3.0 m (6–10 ft)**
- **depending on the growth response after thinning, thin every 5 to 10 years.**

For much more information on sugar bush management, see *A Guide to Improving and Maintaining Sugar Bush Health and Productivity,* produced by the Ontario Ministry of Agriculture, Food and Rural Affairs and partners.



Crop tree selection in the tapped sugar bush

✔ Select trees that are currently good producers.

✔ Select young, vigorously growing Maple trees that will add to the productivity of the sugar bush as soon as they reach tappable size.

✔ Select healthy trees with large crowns.

✔ Retain edge trees – do not thin trees heavily around the borders of the stand as they form an effective windbreak and help stop the movement of invasive and weed seeds into the stand. Their presence also reduces the negative impact of drying winds in the interior of the woodlot.

Trees to remove in improvement harvests

► over-mature, or diseased and defective Maples that are no longer producing well
► low producers – trees producing sap with a sugar content less than 1° Brix
► trees of other species, particularly those that are crowding Maple crop trees
► trees that are a safety hazard

Note: Some maple syrup producers prefer to retain some non-producing species for various reasons (e.g., timber or fuelwood), and this is an option each producer must evaluate when planning an improvement harvest. Retaining other species contributes to diversity but their presence in the overstory of a producing sugar bush may reduce the overall potential of the stand to produce sap.

Managing the tapped sugar bush

The management of a tapped sugar bush involves a continuous program of thinning so that a high sustained yield of sweet sap is obtained.

- ✔ Select individual trees as crop trees. Remove unwanted competing trees individually.
- ✔ Review management options, according to woodlot size. You'll have more options for larger stands; fewer for smaller stands or stands that are overmature and declining.
- ✔ Avoid heavy thinning (reducing BA below 20 m^2/ha [87 ft^2/ac] or removing more than one-third of the original BA).
- ✔ Schedule thinnings at intervals of 10–15 years; this may coincide with a tubing system upgrade.
- ✔ Set a target: a well-managed sugar bush should have a target of 170–220 tap holes per hectare (70–90 tap holes per acre).
- ✔ Thin before trees reach their maximum height to reap maximum benefits from thinning.

In healthy trees, a tap hole will cover over in two to three years. In slow-growing unhealthy trees, it could take many more years.

Tapping Maple trees to maintain tree health and improve sap production

Improper tapping can seriously damage trees, reduce longevity, and decrease sap yields. It should take two to three years for healthy fast-growing trees to cover over 11-mm ($^7/_{16}$-in.) diameter tap holes resulting from use of the traditional spout.

If trees are healthy and showing relatively fast growth, follow the "normal" tapping guideline (see below). If trees are unhealthy, damaged or slow-growing, producers should follow the Conservative Tapping Guideline.

The number of tap holes drilled in a tree each year depends on the diameter of the tree, the state of its health, and operator preferences. Some producers follow conservative guidelines for tapping regardless of tree health.

Tap the trees when the temperature is near or above freezing to reduce cambial damage.

NORMAL TAPPING GUIDELINE FOR HEALTHY TREES

TREE DIAMETER INCHES	(cm)	TAP HOLES PER TREE INCHES
less than 10	(>25)	0
10–14	(26–35)	1
15–19	(36–50)	2
20–24	(51–60)	3
larger than 25	(>60)	3

CONSERVATIVE TAPPING GUIDELINE FOR UNHEALTHY, STRESSED TREES

TREE DIAMETER INCHES	(cm)	TAP HOLES PER TREE INCHES
less than 12	(<30)	0
12–18	(31–45)	1
Greater than 18	(>45)	2

Inoculating shiitake mushrooms.

Inoculated oak bolts in forest.

Forest herb production (wild ginseng).

Harvest-ready shiitake mushrooms.

BMPs FOR SPECIALTY PRODUCTS

Forest farming and gathering

Forest farming practices can be used by woodland owners to grow specialty non-timber forest products, to supplement family income and to encourage biodiversity. Similarly, specialty forest products can be gathered from woodland trees (Cedar boughs, White Pine tips) and plants – irrespective of their value as wood.

In forest farming, high-value specialty crops are grown under the protection (shade and micro-climate) of a forest canopy that has been managed to provide preferred shade levels.

Crops like ginseng, shiitake mushrooms and decorative ferns are sold for medicinal, culinary or ornamental uses. It's a form of double-cropping (like strawberries and peaches): you can generate an annual income while crop trees are being grown for wood products.

Here are some general BMPs for farm forest products.

✔ Manage a small area (<3 ha or 7 ac) intensely to produce multiple crops simultaneously.

✔ Alter the amount of light in the stands by thinning, pruning or adding trees.

✔ Intercrop existing stands of trees with annual, perennial or woody plants. Compatibility among understory and overstory plants and cultural methods is essential.

Before investing time and money in growing a specialty forest product:

▶ obtain production and processing information
▶ locate a source of technical expertise
▶ locate or develop potential markets
▶ prepare a market analysis and business plan (essential!) before starting an enterprise.

Benefits – economic and social

Some products, especially medicinals and botanicals, can have tremendous economic value, while others provide a lower but steady supplemental income.

For example…

▶ Forest-cultivated ginseng averages $44–$88 per 100 g ($200–$400/lb), depending upon how closely the product resembles wild ginseng.

▶ A cord of stovewood worth $50–$100 can produce $500 worth of shiitake mushrooms. Retail prices at time of printing range from $2–$2.65 per 100 g ($9–$12/lb).

▶ Markets for floral decoratives have been steady or increasing.

Forest farming provides opportunities to generate short-term income from existing woodlots, with minimum capital investment. This can contribute significantly to rural economic development and diversification, especially on small family farms.

Woodland gathering

Not all non-timber forest products are cultivated. Plant materials can be pruned from growing trees. If managed properly, and sustainably, this can be done year after year.

Cedar boughs can be harvested for oil production. Care must be taken to ensure that the crown is not over-pruned.

Cedar boughs

Cedar boughs are harvested for cedar leaf oil and for floral use. Production for cedar leaf oil is seasonal while production for floral use can be year-round.

Open-grown young trees with deep crowns are best for bough production.

Harvesting Cedar boughs will not jeopardize the health of trees, unless over 50% of the live crown height is removed. Harvesting of boughs from a young tree can continue for years as the tree grows in height.

Ground Hemlock

Ground Hemlock is a small evergreen shrub that is attracting international attention for its cancer-fighting agents. It grows in upland mixedwood and tolerant hardwood cover types – usually in rich, moist woodlands with a mix of hardwoods and softwoods. It has low, spreading branches 50–100 cm (20–40 in.) long, but can sometimes grow to 200 cm (6.5 ft) or more.

Buyers are interested in the last few years' growth, which extends back about 15 cm (6 in.) from the tip. By only collecting the new growth, you can usually harvest the plant in another four to five years. August to April is the best time to harvest.

The green growth of ground Hemlock contains cancer-fighting chemicals. Only the top 15 cm (6 in.) of the growing tips is harvested to sustain growth.

BMPs FOR MANAGING OLD-GROWTH CHARACTERISTICS AND WILDLIFE

Old-growth forests were common in undisturbed forests that existed throughout southern Ontario prior to the mid 1700s. Today, only a few old-growth forests remain in Ontario.

Old-growth forests provide important habitat for many species of plants and animals. Many of the management recommendations used in Ontario have been developed from guidelines for maintaining both wildlife populations and old-growth characteristics.

Many landowners want to promote wildlife and/or restore or maintain some of the characteristics of old-growth forests in their woodlot. The illustration on the next page describes the important habitat characteristics for wildlife in old-growth forests, and what you can do to promote them in your woodlot.

One of the telling features of old-growth forests are the super-canopy trees – like White Pine in the Temagami region.

Old-growth forests have thick layers of ground plants: mosses, fungi, ferns, shrubs and trees as well as thick layers of decomposing leaves and twigs.

Canopy gaps are small holes that allow light to reach the forest floor and permit trees to regenerate to form an uneven-aged stand with a variety of size classes and multiple canopy layers. To be effective, create a number of canopy gaps in your forest: >10 m (33 ft) wide (by opening 1–2% of forest canopy).

Old/large trees with >50 cm (20 in.) DBH will help create old-growth forests. Leave 27 trees/ha (9 trees/ac) and BA of 7 m^2/ha for 50+ cm.

Pits and mounds form when large trees are uprooted and mineral soil is exposed. They offer the diversity needed by some tree species to germinate.

OLD-GROWTH FOREST AND WILDLIFE HABITAT

Retain trees with stick nests that are currently or have historically been used by large raptors (Hawks, Eagles, Osprey, Owls).

Leave snag trees for wildlife habitat. Pileated Woodpeckers require cavities of about 10 cm (4 in.) in diameter for roosting or nesting.

SUPER CANOPY TREES/ISOLATED CONIFERS. They are landmarks, nesting/resting sites for birds, and refuges for bear cubs. Keep tall trees such as White Pine that reach beyond the canopy.

DECAYING WOOD. Provide habitat for many species, including Woodpeckers, Ruffed Grouse, reptiles, amphibians, and invertebrates. Allow logs and branches to decay naturally on the forest floor – leave at least 10 fallen logs/ha (4 logs/ac).

CAVITY TREES/SNAGS. Up to 25% of the wildlife in forests use cavities for rearing young, roosting, escaping predators or hibernating, e.g., Saw-Whet Owl, Flying Squirrels. Retain 6 cavity trees/ha (2–4/ac) with >25 cm (10 in.) DBH. If not available, leave trees that are declining and should become cavity trees eventually.

MAST TREES. Up to 25% of wildlife species – including Black Bear, Wild Turkey, Ruffed Grouse – eat fruit and nuts from trees. Leave trees that produce edible fruit and nuts such as Oak, Black Cherry, Basswood, Beech, Butternut, Black Walnut, Hickory and Ironwood. Retain 7–8 mast trees/ha (2.8–3.3/ac), preferably with a DBH of >25 cm (10 in.) and with large crowns.

Rodent control may be necessary when establishing tree cover.

BMPs for mitigating wildlife damage in agricultural areas

Wildlife is an important and necessary part of a healthy and sustainable landscape. However, some species like Deer, Black Bear, Wild Turkey, Coyote and Raccoon have dramatically increased in numbers over the past few decades. This can result in many conflicts with farmers who in most cases must pay both the direct cost of the damage as well as the cost of any abatement measures.

Although nuisance wildlife species are not welcome on many farms, there are a number of other species that provide substantial benefits to rural landowners. Species like Red Fox, Red-Tailed Hawk and Great Horned Owls are predators that help control rabbit, mice and vole populations. Swallows and other songbirds help control insect populations in crop fields. Other species such as Cardinal, Ruffed Grouse and Red Squirrel have little or no impact on farm operations.

Additional information and reference material on reducing negative impacts of wildlife are available from:

Ontario Soil and Crop Improvement Association
http://www.ontariosoilcrop.org/
Telephone: 519-826-4214
Fax: 519-826-4224
Email: oscia@ontariosoilcrop.org

Also consult references in Infosheets #22 and #23 of the Environmental Farm Plan, 3rd ed. and the BMP book, *Fish and Wildlife Habitat Management.*

Careful placement of forest trails and access points can help reduce the potential for serious site damage.

BMPs FOR MULTIPLE USES

Other forest values

Forests have many values other than timber, including wildlife habitat, mushroom and berry picking, medicinal plants, and recreational uses ranging from hiking, skiing and horseback riding to hunting and trails for ATVs.

Use these BMPs to maximize the enjoyment and protection of your woodland.

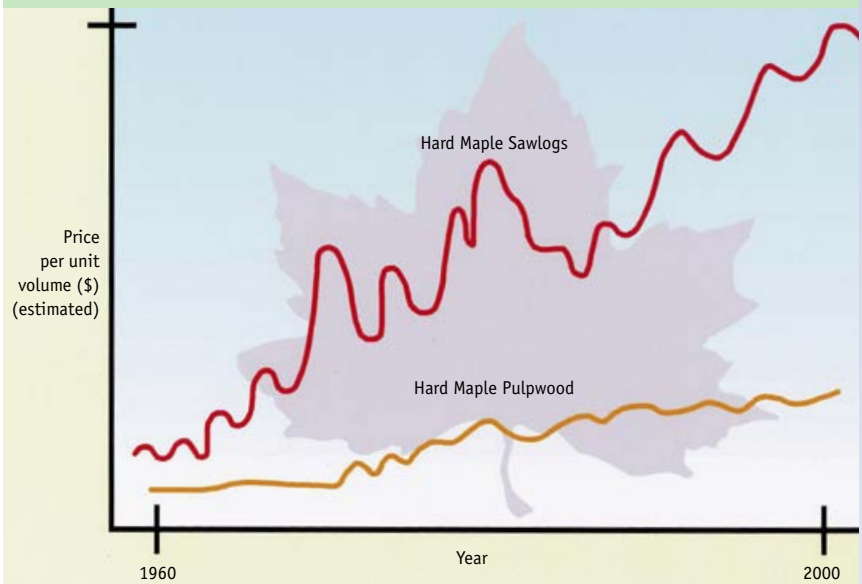
- ✔ Limit the number of trails through your woodlot. Forest access is important, but too many trails, ATVs, access roads, horses and even people compact the soil, trample vegetation, erode streambanks and disturb nesting wildlife. If streams or wetlands must be crossed by trails, limit crossings to one place, cross at right angles and consider installing a culvert or bridge.
- ✔ Be sensitive to other forest values. Responsible forest managers promote a variety of forest uses. Be aware that chainsaws, ATVs, power equipment and loose cats and dogs do impact wildlife, especially nesting birds.
- ✔ Leave some behind. When picking wild leeks, berries, mushrooms etc., leave some behind as a seed source and food for wildlife. Native ginseng has already been over-picked in southern Ontario and is now an endangered species.

- ✔ Use some revenues from forestry operations or tax rebates to work on wildlife or silvicultural projects.
- ✔ Avoid nailing signs and tree stands to trees. Nails damage trees, and are also a hazard when trees are cut or milled. There are many tree stands on the market that chain to a tree, preventing long-term damage.
- ✔ Maintain diversity. A variety of tree and shrub species provides:
  - ▶ more diverse current and future economic opportunities
  - ▶ better resilience of the forest to storms, disease and insects
  - ▶ food and shelter for more wildlife species.
- ✔ Use inventories and tree marking. Tree marking by a certified tree marker is the first step to ensuring a healthy residual stand. Traditional forest harvesting methods such as high-grading and diameter limit cuts are not only poor for future timber sales and productivity, but they also hurt recreation, hunting, wildlife habitat, and aesthetic potential.

BMPs FOR WOODLAND TYPES

In the previous section, we looked at general best management practices for woodland products. In this section, we present BMPs for forest management according to the species, composition, age, stand condition and site type of the major forest cover types discussed in the previous chapter. We'll work through each of the working groups listed in the chart on page 36.

TREND IN SAWLOG AND PULPWOOD PRICES FOR HARD MAPLE, 1960–2000



The market for good quality Maple sawlogs and veneer logs has been growing steadily over many years. High quality veneer logs have sold for $4–6 per board foot. A 36-in. 10-ft log could be worth as much as $3,000 (veneer only) at those prices!

TOLERANT HARDWOODS WORKING GROUP

BMPs FOR TOLERANT HARDWOODS AND HEMLOCK USING OPTIMUM BASAL AREA

AVERAGE DIAMETER OF 0–9 CM (0–3.5 in.)

✔ Allow stand to develop.
✔ Keep any overstory trees to enhance stand and structure.
✔ Protect the understory and the growth of tolerants.
✔ Prevent weed species from invading.

AVERAGE DIAMETER OF 10–24 CM (4–9.5 in.)

✔ Choose a crop tree every 6 metres (20 ft)
- crop trees should have clear, straight stems, no defects or disease, and broad, healthy crowns with good canopy positions.

✔ Release it on 2–3 sides.

AVERAGE DIAMETER OF >24 CM (9.5 in.)

✔ Thin stand and convert to uneven-aged management when BA is >26 m^2/ha (110 ft^2/ac).
✔ Convert from even to uneven by:
- cutting small gaps in the stand, generally around tree height in diameter, to promote new regeneration
- length of cutting cycle will depend on several factors, including marketable timber yields, contracted or landowner harvest, size of stand, and intensity of harvest
- cutting gaps in areas of larger woodlot over several harvests, starting with the removal of poorest quality stems first.

Management options for tolerant hardwoods depend on whether the stand is even- or uneven-aged.

Sapling size class in tolerant hardwoods.

Polewood size class in tolerant hardwoods.

Tolerant hardwoods are composed of hardwoods such as Sugar Maple, Beech, White Ash and Basswood with inclusions of Hemlock, White Pine and Black Cherry.

Mature age class in tolerant hardwoods.

Overmature age class in tolerant hardwoods.

Many tolerant hardwoods in southern Ontario are even-aged. The preferred age distribution is *all-aged* or uneven-aged. A mix of defective and merchantable logs is removed to encourage the regeneration of seedlings and the growth of young trees with potential.

Even-aged stands contain one 20-year age class, and all trees are generally the same size. A second age class may also be present, e.g., a mature canopy and a layer of young saplings.

Uneven-aged or all-aged stands contain three or more age classes, and a wide range of size classes. Uneven-aged management is preferred over even-aged management as harvests can be made more frequently, and stands are generally more attractive for recreation and wildlife.

If you want to encourage mid-tolerant species (Oak, Ash, Hickory, White Pine), use group selection to create openings and promote regeneration.

To retain uneven-aged structure, thin the stand with improvement cutting. When BA > 26–28 m^2/ha (110–120 ft^2/ac), remove one-third of the BA, removing undesirable growing stock or UGS stems from all diameter classes.

Most stands in southern Ontario could be harvested periodically every 10–20 years, depending on location, local climate, site quality, marketable yields and past management practices.

Well-managed uneven-aged stands have a wide age-class distribution that includes seedlings, saplings, polewood and mature trees.

Note: the above approach works best when conditions are most suited to commercial harvest practices. This approach may not be suitable for small inaccessible stands with trees in poor condition.

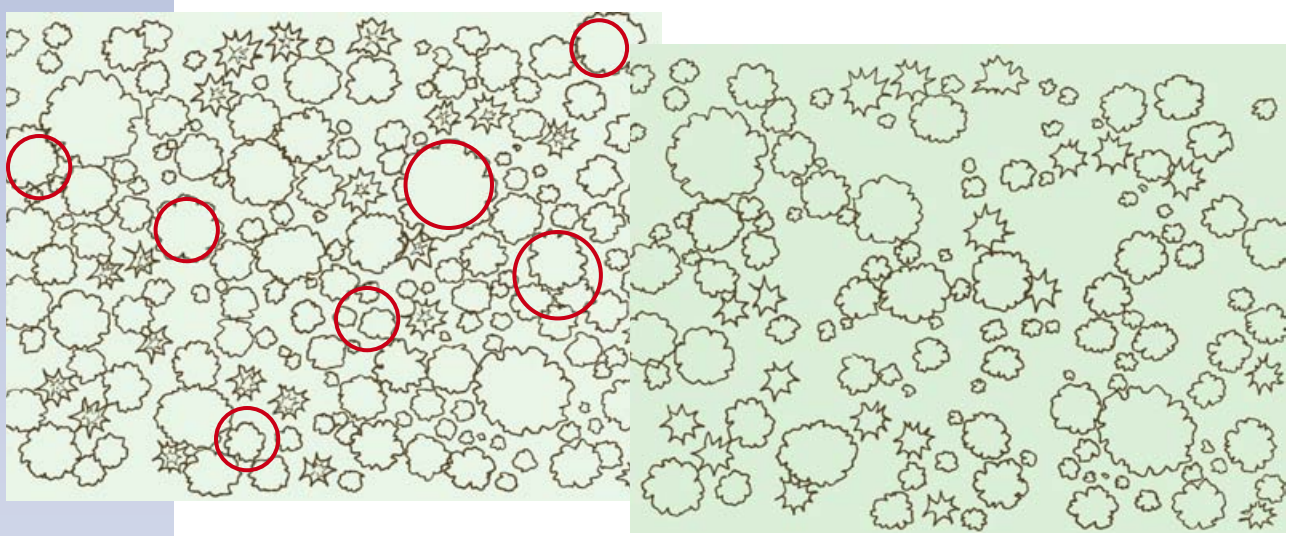
When planning an improvement cut where most of the stems to be removed are defective, include a few trees of commercial value to make the harvest operation more economically viable to the landowner and the operator.

The interval between cuts can be reduced to 7–15 years (instead of 15–30), depending on soils, climate, stand condition and approach. Staged over time, more cuts can be made to harvest sawlogs.

Crop tree selection is another approach to stand improvement. Crop trees can be selected using the following criteria:

- commercially valuable – desirable species
- straight boles or trunks
- defect-free trees
- well-shaped crowns.

Create spacing of 20 feet between crop trees with a series of improvement cuts for polewood stands and commercial cuts for stands with more marketable timber.



This illustration depicts the effect of thinning a woodlot using the crop tree approach. Undesirable and marketable trees (indicated by red circles) are removed to provide space for the crop trees.

UPLAND MID-TOLERANT WORKING GROUP

UPLAND MID-TOLERANT OVERVIEW

SPECIES COMPOSITION	SHADE TOLERANCE	SITE TYPES	STAND AGE*	SILVICULTURAL SYSTEM
• Red Oak, White Ash, Bitternut Hickory White Oak, Bur Oak, Pignut Hickory, Black Walnut, Butternut Black Cherry • May also include: Maple, Basswood, Shagbark Hickory, Red Maple, Beech and Largetooth Aspen	• Dominated by intermediate and intolerant species • Some shade-tolerant species	• Mostly found on well to imperfectly drained (fresh to moist) loamy sites – also sandy loams to clay loams	• Even-aged	• Shelterwood system – group and uniform system • Group selection

* Stand age and condition determine whether the stand is mature and ready for harvest and regeneration.

Upland mid-tolerant hardwoods are composed of valuable hardwoods with intermediate shade tolerance requirements. These stands are also known as Oak-Ash-Hickory types – commonly found in the Carolinian zone (Site Region 7E).

IF THE STAND IS LESS THAN 60 YEARS OLD	
MANAGEMENT ACTION	**BMP FOR UPLAND MID-TOLERANT SPECIES**
IF THE UNDERSTORY IS NOT PREDOMINANTLY SHADE-TOLERANT	✔ Thin stand using crop tree management (improvement cut). ✔ Choose a crop tree every 6 metres (20 ft) and release it on 2 or 3 sides. ✔ Choose trees with straight stems, no defects or diseases, large healthy crowns and good canopy positions. ✔ Make several improvement cuts until you achieve desired results.
IF THE UNDERSTORY IS PREDOMINANTLY SHADE-TOLERANT (i.e., contains Maple and Beech)	✔ Use group selection techniques. Or, ✔ Reduce the number of improvement cuts to reach desired spacing for crop trees so as to encourage regeneration of intermediates. ✔ Harvest in dry conditions (late summer or early fall) to promote scarification.
IF THE STAND IS GREATER THAN 60 YEARS OLD (60-80 YRS), IT MAY BE READY FOR HARVESTING AND REGENERATION	
IF BA >12 m^2/ha (52 ft^2/ac)	✔ Use shelterwood system. ✔ Remove overstory (gradually) in a series of harvests. ✔ Use a prep cut to remove undesirable (non-target) species, e.g., Maple and Beech. ✔ Release seed trees. Twenty years later, remove defective, smaller trees and open canopy to 50% canopy closure. ✔ Once regeneration is established, remove the canopy to release the new saplings, usually once regeneration is 4.6–6 metres (15–20 ft) tall.
IF BA <12 m^2/ha (52 ft^2/ac)	✔ Use group selection to create larger openings around mature trees.

In 2005, in some areas, Oak sold for as much as $1.20–$2.00 per board foot (veneer logs at roadside).

Upland mid-tolerant stands often originate from heavy partial cutting in a farm woodlot.

Group selection in mid-tolerant hardwood stands involves small areas of merchantable and lower quality trees being harvested to encourage regeneration of trees with low shade tolerance.

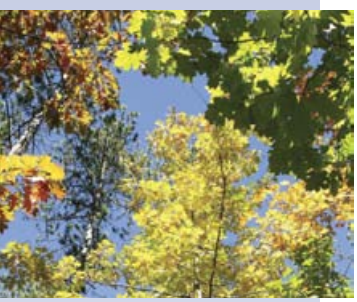
The shelterwood system – where the overstory is removed in a series of harvests – is recommended for mid-tolerant woodlots with a high basal area.

UPLAND MIXEDWOOD WORKING GROUP

UPLAND MIXEDWOOD OVERVIEW

SPECIES COMPOSITION	SHADE TOLERANCE	SITE TYPES	STAND AGE*	SILVICULTURAL SYSTEM
• White Pine, Red Oak, Red Pine, Red Maple, White Birch, White Ash, Hard Maple • Also Hemlock, Trembling Aspen, Largetooth Aspen, Jack Pine	• Dominated by intermediate and intolerant species • Some shade-tolerant species	• Mostly found on rapidly to imperfectly drained (dry to fresh) sandy sites or on shallow to bedrock (ridge sites)	• Even-aged • Fire-origin from 100 years ago	• Shelterwood system – group and uniform system • Group selection

* Stand age and condition determine whether the stand is mature and ready for harvest and regeneration.



Most upland mixedwoods originate from severe fires that followed historic Pine harvests.

Upland mixedwoods are composed mostly of White Pine, Red Pine, Red Oak and Red Maple with an assortment of other hardwoods and softwoods.

IF THE STAND IS LESS THAN 80 YEARS OLD	
MANAGEMENT ACTION	**BMPs FOR UPLAND MIXEDWOOD**
THIN STAND USING CROP TREE MANAGEMENT	✔ Choose a crop tree every 6 m (20 ft) and release it on 2 or 3 sides. ✔ Choose crop trees with straight stems, no defects or diseases, large healthy crowns and good canopy positions.
IF STAND IS PREDOMINANTLY PINE	✔ Use a density management diagram for natural Pine stands just like for Red Pine stands.
IF THE STAND IS GREATER THAN 80 (80–100 YRS)*	
IF BA IS >12 m^2/ha (52 ft^2/ac) WITH OAK AND PINE	✔ Use shelterwood silvicultural system. ✔ Remove the overstory in a series of harvests. ✔ Start with a preparatory cut, remove unwanted (undesirable or non-target species), e.g., Poplar and Birch (including Yellow Birch) and release seed trees. ✔ Remove defective, smaller trees and open up the canopy to 50% after 20 years. ✔ Once regeneration is established, remove the canopy to release the new saplings, (usually when regeneration is 4.6–6 m (15–20 ft) tall.
IF BA IS <12 m^2 (52 ft^2/ac) WITH OAK AND PINE	✔ Use group selection to create larger openings around mature trees.

* This varies with soil, site and climate. In most cases this applies to younger stands in southwestern Ontario.

Shelterwood cuts are recommended for stands that consist mostly of Pine and Oak. This encourages the maintenance of Oak and Pine in the understory.

EARLY SUCCESSIONAL WORKING GROUP – BIRCH AND ASPEN

EARLY SUCCESSIONAL OVERVIEW

SPECIES COMPOSITION	SHADE TOLERANCE	SITE TYPES	STAND AGE	SILVICULTURAL SYSTEM
• Trembling Aspen, White Birch and Black Cherry • Other common species may include mid-tolerant species, White Pine, Elm, Green Ash	• Dominated by intolerant species	• More prevalent on sandy to loamy soils, shallow sites, rapid to well-drained (dry to fresh sites)	• Even-aged	• Clearcut and shelterwood system

Poplar/Birch or intolerant hardwoods are often found in old fields or on forest sites with a history of regular disturbances such as fires and clearcut harvests.

Some areas of Ontario have relatively low amounts of *early successional forest*. In recent years, the demand for good quality Birch logs has grown.

Clearcutting mature Poplar/Birch stands is a sound management choice if you want to encourage shade-intolerant species such as Poplar, Birch and Black Cherry.

IF YOUR STAND IS 10–40 YEARS IN AGE	
MANAGEMENT ACTION	**BMP**
THIN TO MAXIMIZE GROWTH AND RELEASE BEST STEMS EVERY 10TH, 20TH AND 30TH YEAR FOR MAXIMUM GROWTH	✔ Through thinning maintain a density of 2,500, 1,250 and 625 stems/ha (1,000, 500 and 250 stems/ac). ✔ Avoid damaging remaining stems. Poplar and Birch are susceptible to infection.
IF YOUR STAND IS 40–80 YEARS OLD	
MONITOR FOR FOREST DECLINE. POPLAR AND BIRCH DECLINE RAPIDLY AT THIS AGE	✔ Harvest if necessary. Harvest when losses from mortality and decay become unacceptable.
IF YOUR STAND IS OVER 80 YEARS OLD	
CLEARCUT TO KEEP IT IN EARLY SUCCESSIONAL STAGE, OR GRADUALLY REMOVE THE OVERSTORY TO RELEASE ADVANCED GROWTH OF TOLERANT AND MID-TOLERANT SPECIES	✔ Clearcut to promote root suckering and full light for maximum growth. ✔ Favour tolerant hardwoods if present. ✔ Don't open up canopy too fast, or Poplar/Birch will seed in and out-compete other seedlings. ✔ Retain pockets of Poplar/Birch in the stand. Cut canopy gaps up to two tree heights in diameter. Cut Poplar and Birch to promote root suckering.

LOWLAND HARDWOOD WORKING GROUP

LOWLAND HARDWOOD OVERVIEW

SPECIES COMPOSITION	SHADE TOLERANCE	SITE TYPES	STAND AGE	SILVICULTURAL SYSTEM
• Soft Maple (Silver, Red or Silver/Red cross), Green Ash, Black Ash, White Ash, Shagbark Hickory • Cedar, Balsam Fir, Basswood, Cherry, White Elm, Yellow Birch	• Dominated by shade-tolerant and mid-tolerant species	• Mostly found in poorly to very poorly drained (moist to wet) deep sites	• Generally even-aged but may be uneven-aged	• Selection system

Lowland hardwoods, consisting of Ash and Soft Maple, are found in treed swamps and poorly drained woodlots adjacent to swamps.

Lowland hardwoods, while not as economically valuable as other working groups, are an important part of our landscape.

Lowland hardwoods are more suited to selection systems where improvement cuts are staged over several harvest operations.

Lowland hardwood woodlots have their own unique management challenges. Many sites are associated with water features and may be diverse in species and excellent in productivity, but are on fragile sites that require extra caution. Manage in the same manner as you would a tolerant hardwood stand.

- ✔ Be cautious when working on moist soils – operations are limited when the ground is soft.
- ✔ Focus management activities on better drained sites, if possible.
- ✔ Don't over-harvest. Removing too many trees may cause a rise in the water table, possibly killing the remaining trees.
- ✔ Overharvesting may also promote windthrow, as many lowland hardwood trees are shallow-rooted.
- ✔ Cut stumps low and avoid excessive damage as coppice regeneration is important in swamps.

WHITE CEDAR AND LOWLAND MIXEDWOOD WORKING GROUP

WHITE CEDAR AND LOWLAND MIXEDWOOD OVERVIEW

SPECIES COMPOSITION	SHADE TOLERANCE	SITE TYPES	STAND AGE	SILVICULTURAL SYSTEM
• White Cedar, Tamarack, Balsam Fir, White Spruce, Balsam Poplar, White Birch, Trembling Aspen	• Dominated by intolerant and tolerant species	• Poorly drained (moist to wet sites) – predominantly on loamy sites	• Usually even-aged	• Selection, shelterwood and clearcut

Lowland mixedwoods are more suited to selection systems where improvement cuts are staged over several harvest operations.

IF STAND IS 50–80 YEARS OLD	
STAND CONDITIONS	**BMPs FOR WHITE CEDAR AND LOWLAND MIXEDWOODS**
BA >44 m^2/ha (190 ft^2/ac)	✔ Reduce BA to 30 m^2/ha (130 ft^2/ac) by reducing the BA by one-third. ✔ Remove stems that are in multiple clumps, forked stems, stems with poorly developed crowns. ✔ Mark to release healthy single stems of above-average diameter with healthy crowns and canopy position.
IF STAND IS MATURE – 80–120 YEARS OLD	
IF THE STAND AREA IS >4 ha (10 ac)	✔ Remove Poplar and White Birch 10 years prior to planned Cedar harvest to: • reduce the likelihood they will reproduce in the Cedar stand • control other species (e.g., Birch) to avoid poor Cedar regeneration.
IF THE STAND AREA IS <4 ha (10 ac)	✔ Use shelterwood system to regenerate the stand. ✔ Reduce BA to 14 m^2/ha (60 ft^2/ac) in first cut of shelterwood. ✔ Mark trees to retain the highest quality trees with the largest crowns (best seed source). ✔ Once new Cedar regeneration is established, remove remaining trees (before regeneration is >3.1-m [10-ft] tall).
USE PATCH CLEARCUT ON STANDS <10 ha (25 ac)	✔ Cut 100 x 100-ft blocks to allow new regeneration to seed in.
USE STRIP CLEARCUT ON STANDS >10 ha (25 ac)	✔ Cut blocks 18x75 m (60x250 ft) to allow new regeneration to seed in.

White Cedar forms pure stands on shallow limestone soils in eastern Ontario and the Bruce Peninsula. Mature White Cedar stands can be difficult to maintain.

The demand for White Cedar lumber has been growing in some parts of Ontario.

White Cedar can be found growing in association with Tamarack, White Spruce, and shade-intolerant hardwoods on some lowland sites.

BMPs FOR PLANTATIONS

Plantations are planted woodlands. The most common plantation found on Ontario farmland consists of a single conifer species, all the same age and planted in rows. Plantations were established this way to assure tree survival and to attain crown closure in the shortest possible time. Close-spaced trees – just like polewood hardwood stands – require thinning to reduce mortality, maximize growth and produce marketable products.

Tree plantations can be very rewarding if they're properly maintained. This chapter explains the principles and practices of:

- ▶ thinning – why, when and how
- ▶ pruning
- ▶ general care.

The reasoning was that plantations could stabilize the soil, stop the spread of drifting sands, and rehabilitate fragile lands with forest cover. Once established, these plantations would generate forest products and remain as forest land.

Many older plantations date back to before the Great Depression. At that time, government programs were established to encourage tree planting on "wastelands" – abandoned farm-lands with "blow" sands and severe washouts.

In the latter half of the 20th century, more diverse plantations were established to retire fragile and marginal lands or simply to serve as an alternative land use to agriculture.

Today, there is a trend towards diversity or specialization in recently established plantations. Some newer plantations consist of a wide mixture of conifers and hardwoods, trees and shrubs to attract wildlife; others have been planted to generate specialty products such as veneer hardwoods, nuts, maple syrup and forest farming products.

Fragile lands are croplands that are prone to severe water erosion, wind erosion, compaction and flooding. They may still be productive but have a high risk of degradation.

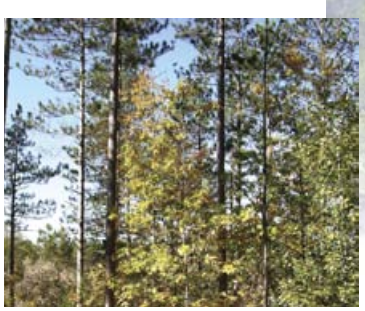
Marginal lands are crop or pasture lands that, due to their soil and landform features, are only marginally productive as farmland. Such lands are often too stony, dense, dry, wet, shallow or steep for profitable farming with conventional crops.

TYPES OF PLANTATIONS

Most established plantations found in Ontario are made up of one of the following:

- conifers – single or multiple species
- hardwoods – single or multiple species
- mixedwoods – a mixture of conifers and hardwoods and in some cases, shrubs
- specialty plantations – fibre, biomass, maple sugar, Christmas trees, and orchards.

Conifer plantations are the most common type found in Ontario. Most are single species (e.g. Red Pine, White Spruce), but some consist of two or more species. Conifer plantations were often established to retire fragile or *marginal lands*. When managed, these stands produce poles, sawlogs, posts and pulpwood. Many are converted to more naturalized mixedwood stands.



Hardwood plantations are not that common in Ontario. In many cases, single or multiple species of valuable hardwoods were established on small acreages in field corners, adjacent to farm woodlots, near farmsteads or on floodplains. They require intensive levels of management to outperform weed competition and to generate products such as timber and maple syrup.

Mixedwood plantations are often found in areas near watercourses or on poorly drained lands. They consist of one or more species of conifers (e.g., White Pine, Norway Spruce) and one or more species of hardwoods (e.g., White Ash). The intent of these plantings was to provide cover with a hardwood seed source, control the rate of snowmelt, or to protect sensitive groundwater areas. These plantations are richer in diversity, than single-species plantations.

Specialty plantations of fast-growing hardwoods provide short-rotation pulp or biomass energy products. As with hardwood plantations, careful attention is needed to ensure establishment and optimal growth. In these plantations, trees are managed as coppices following harvest.

RAW WOOD PRODUCTS AND THEIR ORIGINS

PRODUCT	PLANTATION TYPES	TYPICAL SPECIES
POLES	Conifer – Pure, Mixed	Red Pine, White Pine
SAWLOGS	Conifer, Mixed, Hardwood	Red Pine, White Pine, White Spruce, Norway Spruce, European Larch, Red Oak, White Ash, Black Walnut, Black Cherry, Sugar Maple, Silver Maple
VENEER	Hardwood, Mixed	Oak, Walnut, Ash, Maple, White Pine
FENCING MATERIAL	Conifer, Mixed	White Cedar, European Larch, White Spruce, Norway Spruce
FUELWOOD	Mixed, Hardwood	Oak, Ash, Maple, Larch
FIBRE (PULP)	Specialty	Hybrid Poplar, Silver Maple, Red Maple
MAPLE SYRUP	Specialty, Hardwood	Sugar Maple, other Maples
FIBRE (BIOMASS)	Specialty	Red Maple, Silver Maple, Hybrid Poplar, Willow

PRINCIPLES OF PLANTATION MANAGEMENT

Some plantations are actually abandoned Christmas or nursery tree plantations. These can be challenging to manage for forest products.

Managed plantations can provide these significant benefits:

- a good source of revenue
- wood and energy products for on-farm use
- cover and protection from wind and water erosion
- a productive, alternative land use for marginal cropland
- protection for lands associated with sensitive water sources
- a way to expand or connect existing forests and other natural areas
- a "sink" for carbon dioxide – to reduce atmospheric levels of greenhouse gases
- landscape diversity
- encouragement of succession from field to natural forest.

Consider hiring a forestry consultant for advice. A consultant can help to:

- **avoid costly mistakes**
- **represent your interests**
- **explain the methods of management**
- **maximize your returns and other benefits.**

Some trees are planted "off-site". The dying Red Pine trees in this plantation are over 25 years old and are now showing complete intolerance to high lime soils. High lime conditions can be found on sites with a history of severe soil loss.

There are several ways to manage a plantation. Management options for plantations are determined by:

- your objectives – what are your short- and long-term goals
- species planted – the function and benefits of tree species differ
- site conditions (soil type and moisture) – better productivity means more choices
- tree density – dense plantations are ready for thinning
- age of the plantation – it's easier to start them young
- condition of the plantation – healthy stands means more options.

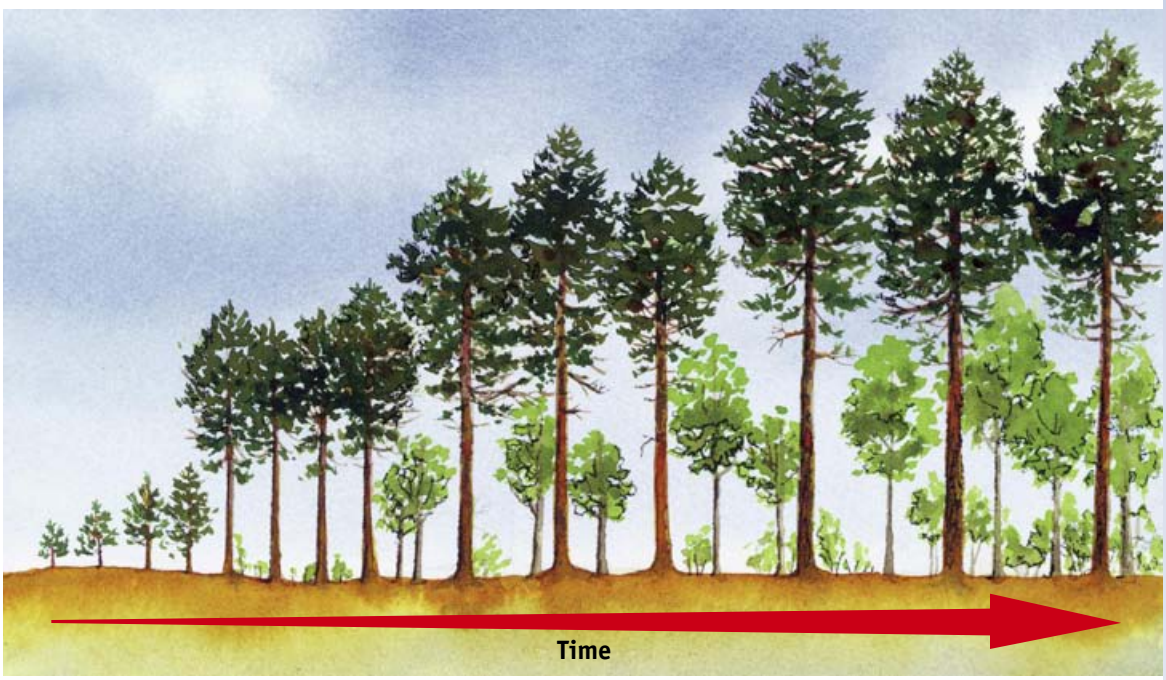
Plantations, like natural woodlands, change over time. Often planted at densities that may be as high as 2,400 seedlings per hectare (1,000/ac), they grow at a rate that is influenced by the site and species. By the time your plantation is ready for its final harvest, the density will be much lower, often in the 200–400 trees per hectare (80–150/ac) range.

A plantation can be thought of as a crop where the management objective is to grow the best trees to maturity ("crop trees") – trees that give the highest yield and return on investment – while serving as a nurse crop for natural regeneration. By conducting a number of well-timed thinnings where the poorest trees are removed and better quality trees are left, you'll be able to maximize the potential benefits. Failing to manage your plantation may result in greatly diminished economic and environmental returns.

Unthinned plantations produce trees that are structurally weak and small-crowned. These trees are prone to ice and wind damage.

LIFE CYCLE OF A CONIFER PLANTATION

Knowing how a plantation develops is essential to understanding how to manage it. Let's start with the life cycle of a conifer plantation.



Plantations can be managed in a number of ways. In this example, Red Pine has been established on a dry sandy site to stabilize the site and grow high value sawlogs and polewood. After 80 years, the Red Pine will be harvested as poles, leaving a new forest of hardwoods on the site.

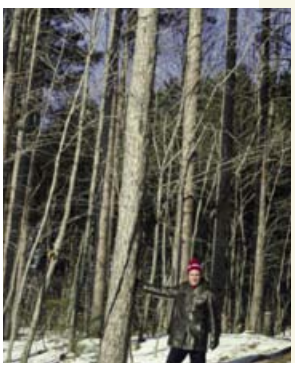
GROWTH STAGES OF CONIFERS

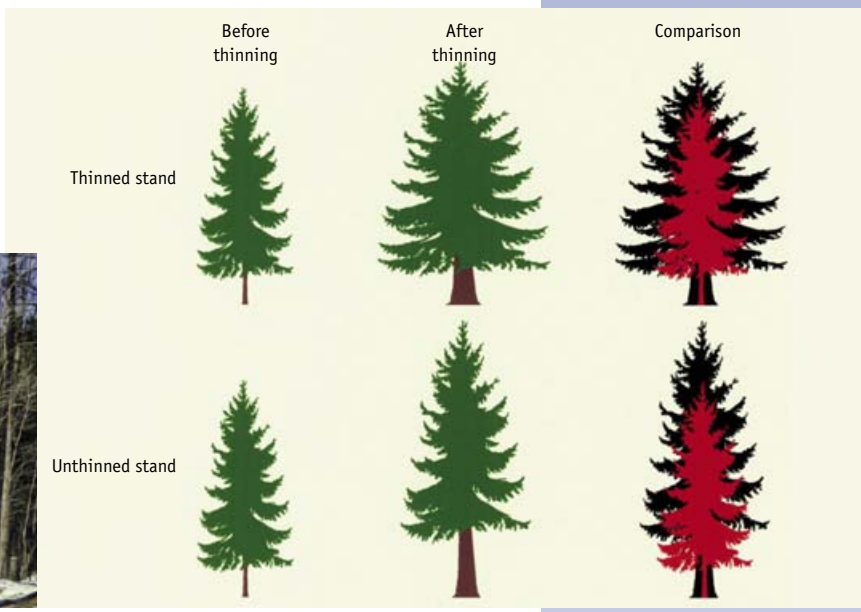
STAGE	ESTABLISHMENT (0–3 years)	RAPID GROWTH (3–30 years)	ACTIVE MANAGEMENT (15–60 years)	SPECIES CONVERSION (>60 years)
TYPE OF GROWTH	• Exploitation by roots • Shoot growth	• Root differentiation • Fast height growth • Small crowns • Minimal diameter growth	• Lateral extension of roots • Slower height growth • Larger crowns • Maximum diameter growth	• Root diameter growth • Slower height growth • Fully developed crowns • Steady diameter growth
STAND DYNAMICS	• Competition with weeds and natural vegetation	• Inter-tree competition • Suppression of slow-growing trees • Mortality of suppressed trees	• Removal by thinning • Crown classes form • Volume increases • Spaces filled by residual-dominants + understory regeneration	• Crop tree removal by harvest • Volume growth steady • Spaces filled by intermediates and natural regeneration
MANAGEMENT IMPLICATIONS	• *Site preparation* • Weed control • Refill may be needed	• Stand protection • Prune crop trees • Thinning to create access	• Successive thinnings • Crop tree pruning • Pest management	• Crop tree harvest • BMPs to avoid damage to site and to young trees

WHAT HAPPENS WHEN YOU THIN A PLANTATION

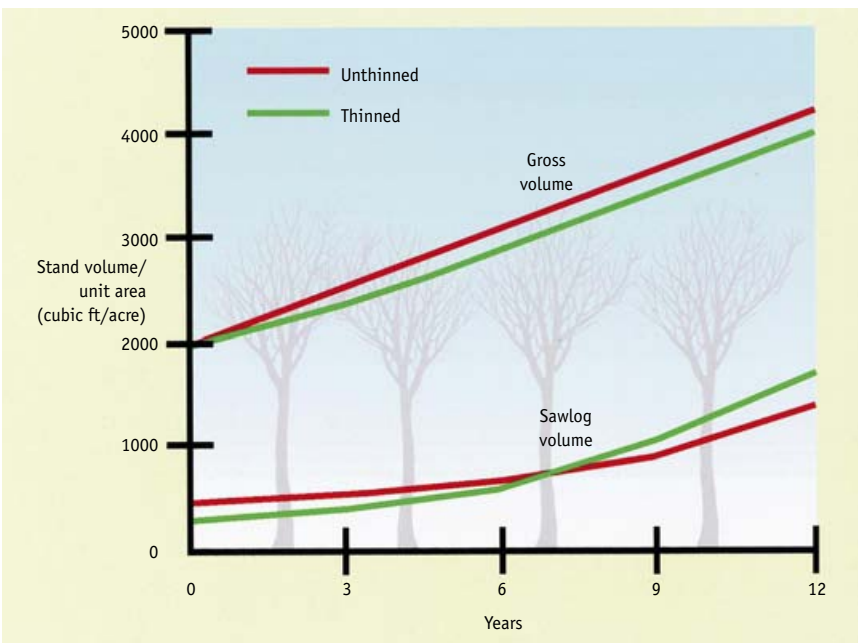
- ► an increase in tree growth – not visible until one or two years following thinning
- ► roots and crown need time to develop before diameter grows
- ► crown diameters and lengths are greater in thinned vs. unthinned plantations
- ► residual trees will be more vigorous, increase sugar production and increase uptake of water and nutrients
- ► lower mortality rate in thinned stands, especially selectively thinned stands
- ► average tree diameter is greater in thinned stands
- ► dominant height growth is similar between thinned and unthinned – height growth is primarily a reflection of site quality
- ► stand volume of thinned stands can be less than unthinned: however, the merchantable volume is substantially greater

- thinning response is greatest in selectively thinned stands as opposed to stands subjected to row thinning only
- timing is everything: stands thinned early (15–25 years old, depending on site quality) have more dramatic responses to thinning
- stands receiving first thinnings late in their cycle do not perform as well: some tree crowns from dense stands can't generate sufficient new growth to increase diameter





Trees in unthinned plantations develop short and narrow crowns, resulting in slow diameter growth. Trees in thinned stands develop greater diameter growth and have less taper.



After thinning, the proportion of merchantable volume continues to increase with time, even though the total volume may be reduced. In unthinned stands, the gross volume continues to increase, but the proportion of merchantable volume decreases dramatically with time.

PLANTATION MANAGEMENT SYSTEMS

The management of a plantation is reasonably straightforward: trees are planted and maintained, they grow, and when they get too dense they are thinned. Thinning is a silvicultural treatment that reallocates stand growth throughout an evenly spaced population of crop trees.

Thinning can:

- ► increase net value of a stand
- ► provide cash flows from thinning sales
- ► improve stand health
- ► diversify stand composition and habitat.

The trick is to time your thinning and plan the intensity of removal so that the trees grow at their optimum rate and the plantation remains as healthy as possible.

A thinning method is a specific strategy to select plantation trees for removal.

A **selective method** is where individual trees are removed according to specifications of size, quality, crop tree spacing or species. In most cases, trees with lower growth potential – smaller, diseased and overtopped trees – are the ones that are removed.

A **systematic method** removes a fixed proportion of a given stand, such as removal of complete rows or corridors to improve access for harvest equipment.

Integrated approaches are usually the best, where operational challenges are taken into consideration and maximum growth of crop trees is promoted.

It's also important to consider the combined effects of intensity (proportion removed) and timing (stand age at thinning) on silvicultural objectives. Thinning at the optimal intensity will prolong thinning response (volume growth); whereas thinning at the best time will maintain growth rates and prevent stagnation.

Well-timed plantation thinnings will improve the overall vigour, growth potential and value of your plantation.

There are two main approaches to selective thinning.

Thinning from below – removing shorter and small-diameter trees

- ► at low intensities, overtopped trees are removed
- ► at subsequent thinnings, only the dominant trees are left
- ► most suitable to single-species stands with uniform site and growth characteristics

Thinning from above

- ► intent is to remove co-dominant and dominant trees with poor crowns and low potential for growth
- ► more suitable in stands with variable stand and site quality

This is an even-aged Pine plantation at 20–25 years of age in the pre-thinned condition.

PRE-THINNED

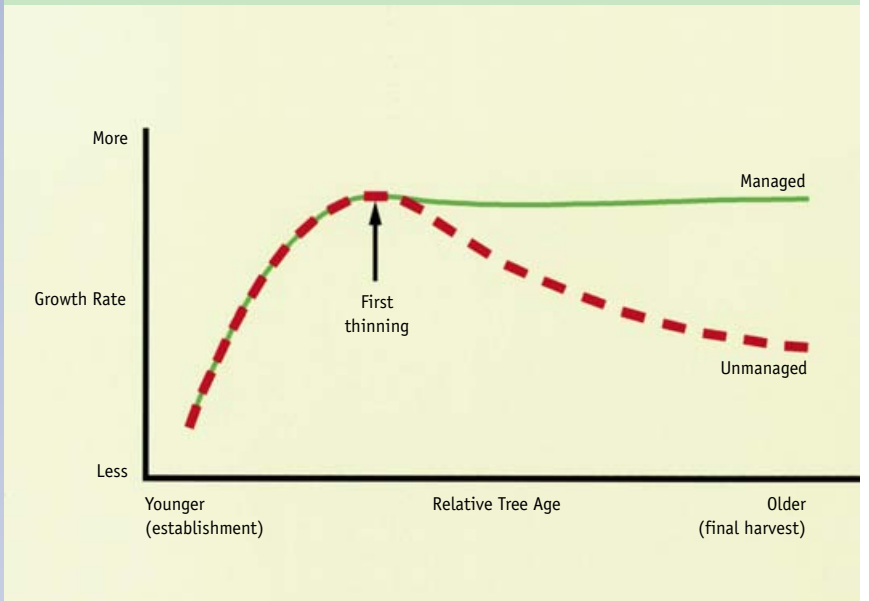
After thinning to create access, the strategy in this thinning regime is to selectively thin smaller and defective trees to provide space for crop trees.

THINNING FROM BELOW

In this thinning regime, larger trees – both merchantable and defective – are removed to provide space for smaller growing trees.

THINNING FROM ABOVE

EFFECTS OF THINNING ON GROWTH RATE



When a plantation is first established, it grows quickly due to an abundance of light and space. Over time, the crowns begin to touch and the growth rate slows and eventually begins to plateau. It's at this point that the first thinning should be done. After this, regular well-timed thinnings keep growth at its highest rate. In unmanaged plantations, crowding continues to cause the growth rate to drop off.

The larger-diameter and healthier trees in managed plantations will generate more revenue.

Fewer trees in unmanaged stands reach their potential growth and value because they are overstocked.

The average time between thinnings varies considerably and depends on five main factors.

1. **Site quality** – trees grow faster on better sites.
2. **Tree density** – plantations with a higher density (more trees/acre) will need less time between thinnings.
3. **Species planted** – some species grow faster than others.
4. **Environmental variables** – drought, insect attack and disease can stress trees, which slows growth.
5. **Intensity of the previous thinning** – the more trees that are removed, the longer it is between recommended thinnings.

Sawlogs can be grown on a range of sites and require thinnings to maintain rapid diameter growth.

Generally, first thinnings are most often required 15–30 years after planting. Subsequent thinnings will be required about every 8–12 years afterwards.

Management decisions are based on site conditions, tree growth characteristics (silvics), and tree status (size, density and condition). These are addressed in some detail in the next section of this book.

Also, remember to factor the following into your decision-making.

Market conditions and opportunity – sometimes it may be possible to hold off harvesting until poor market conditions improve. There is usually a window of 2–5 years when a stand should be thinned before growth slows down.

✔ Research current market trends and opportunities for several years before you plan to harvest.

✔ Know how your stand is doing and estimate when thinning might be recommended. Don't wait too long to take an inventory of your plantation.

Final product objective – the desired final product will influence your decisions of when and how much to thin. For example, if you wish to grow utility poles, the trick is to choose productive sites and conduct frequent low-intensity thinnings from below. This promotes the growth of cylindrical-shaped trees with modest crowns and small lateral branches (i.e., smaller knots), resulting in higher quality utility poles.

Ideal conditions for pole production include good sites, fast height growth and frequent light thinnings to prevent knots.

✔ Research market requirements for your desired final product.

✔ Determine if your current management plan will eventually achieve the desired end result. Adjust plan if necessary and if possible.

Some plantations can be thinned with machinery like this mechanized harvester. The long boom on the front of this harvester allows it to reach out to selected trees in amongst the rows.

GENERAL BMPs FOR THINNING CONIFER PLANTATIONS

Plantations are usually managed through a series of thinnings.

First thinning

- removes an entire row and some of the trees in the remaining rows
- provides access for machinery
- promotes growth of the remaining trees
- is most beneficial when the plantation is 10–30 years old

Subsequent thinnings

- usually occur every 8–10 years
- involves individual trees being selected based on their size and form – usually the poorest and smallest trees are chosen first
- promotes natural regeneration of hardwoods and occasionally softwoods such as Eastern Cedar and White Pine, as trees seed into the plantation
- frees up space for the remaining trees and for other trees species to seed in (i.e., conversion to natural stand)
- reduces the plantation's density gradually, although some trees may be left in the stand for diversity

Plantations are thinned to increase the amount of space and other resources available to the remaining trees. Taking out an entire row during the first thinning opens the stand up for future access.

Here are three examples of management options for a plantation of Red Pine. Note how each option is based on landowner objectives and site potential, which help guide the actions taken.

Option 1: Manage for sawlogs and square timber logs for log homes

▶ best for drier sites – where height growth potential is modest at best

✔ Keep the trees growing at their fastest possible rate

- ▶ this is done by controlling the density through thinning
- ▶ most plantations will need three or more thinnings over their lifetime – this is especially true for log-home logs and utility poles where height and diameter directly influence the potential value of each tree harvested.

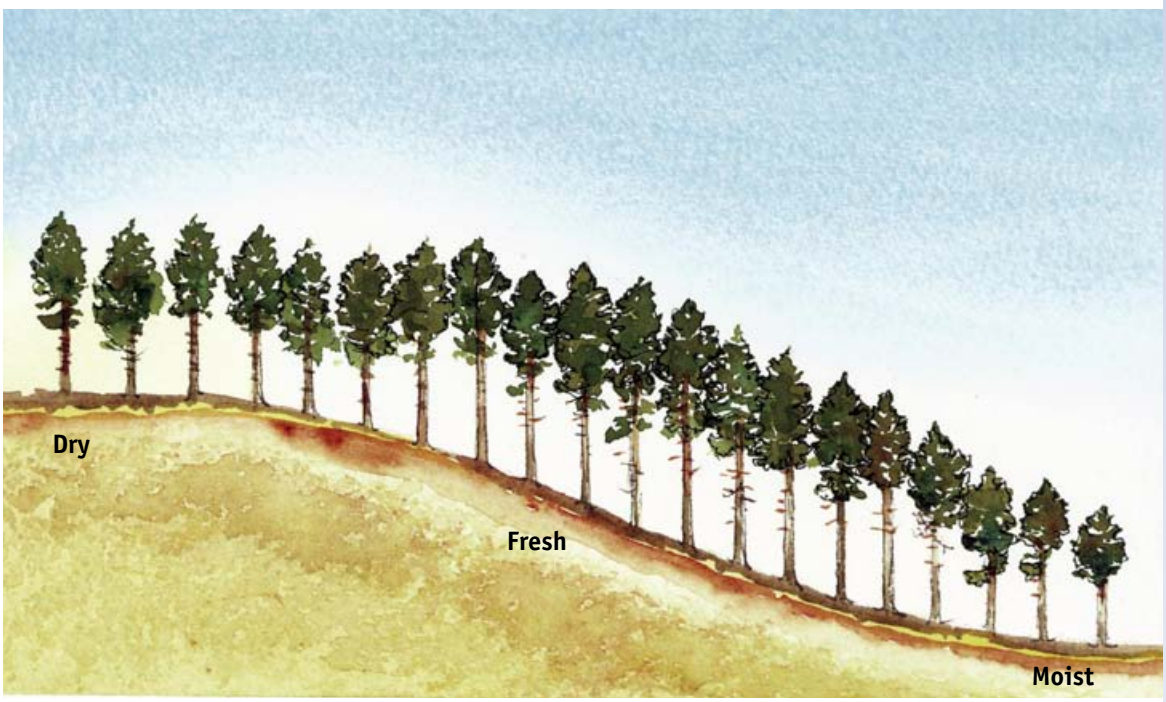
✔ Grow large trees with large crowns

- ▶ thin from below
- ▶ favour crop trees with high potential for crown development
- ▶ prune crop trees for added value.

✔ Capitalize on market opportunities

- ▶ the price paid on harvested products varies from year to year
- ▶ consider delaying harvesting if market price is low.

✔ Use timely and well-planned harvests as a tool to help achieve these BMPs.



Site conditions can influence growth potential and management practices. In this plantation, Red Pine trees were planted from the top to the bottom of this sandy hill. Due to available moisture, the trees grew best in the mid-slope position and were thinned lightly to develop poles.

Option 2: Manage for utility poles and round logs for homes

▶ most suited for well-drained fresh sites where height growth is rapid

✔ Keep the trees' height growth at its fastest possible rate:

- ▶ this is done by controlling the density through careful thinning
- ▶ select crop trees and remove any inferior trees that interfere with height growth
- ▶ thin to keep diameter growth at a modest rate – so that trees will have more compacted growth rings to enhance structural strength.

✔ Grow large trees with medium-sized crowns:

- ▶ thin from below in several thinnings to keep spacing tighter than for sawlogs
- ▶ favour crop trees with small lateral branches and healthy crown development
- ▶ prune crop trees for added value to reduce knots.

✔ Capitalize on market opportunities:

- ▶ the price paid for harvested products varies from year to year
- ▶ consider delaying harvesting if market price is low.

Height growth was slower at the top of the slope and in the lower slope area. The Pine on these sites were thinned more heavily to produce sawlogs and to encourage the regeneration of local, native species. The Pine growing in the midslope position were thinned lightly to discourage rapid crown devlopment, large-diameter lateral branches in the crown, and knots.

Option 3: Promote hardwood forest regeneration within the stand adjacent to an existing hardwood forest

✔ Thin as soon as the plantation needs to be thinned.

✔ Remove the maximum recommended number of trees.

✔ Protect hardwood regeneration (if desired) during thinning.

✔ Under-plant hardwoods, White Pine or White Cedar in areas that are not regenerating naturally and where site conditions are suitable.

INDICATORS FOR THINNING

Choosing the right method

There are two methods of managing plantations:

1. Basal Area Reduction
2. Density Management Diagrams.

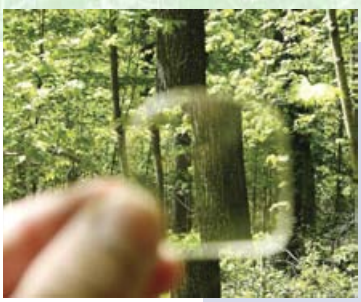
Basal Area Reduction (BAR)

This involves using a prism to measure the initial basal area of the plantation, and:

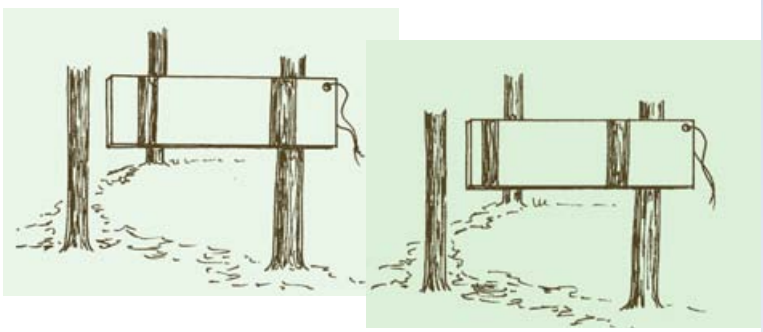
- ▸ thinning to reduce the overall basal area (BA) of the stand
- ▸ achieving a desired BA based on the initial BA determination
- ▸ reducing the overall BA by a set percentage.

A prism may be used to determine basal area. A tree is counted "in" if the stem seen through the prism overlaps the stem seen through the naked eye. A stem is counted out if it doesn't overlap the stem as seen through the naked eye. The basal area of the stand is the total of all the "in" trees counted in a circular plot multiplied by the BA factor of the prism (usually 2).

Example: 14 trees counted in. BA = 14 x 2 = 28 m^2/ha (120 ft^2/ac).



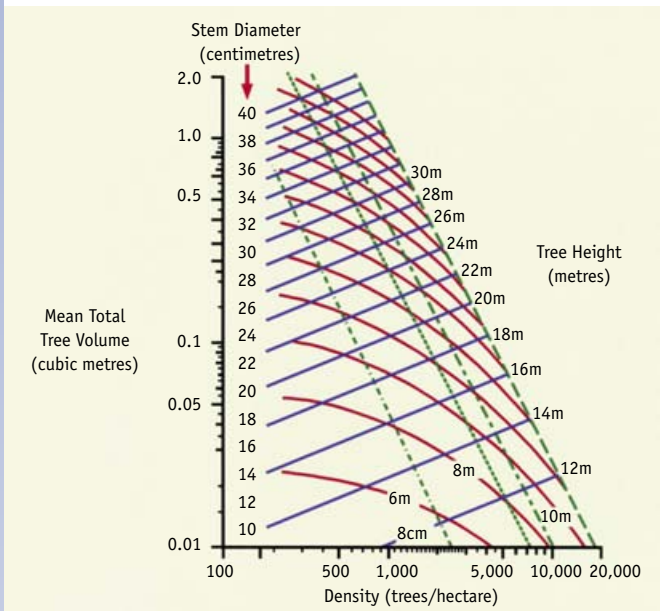
Proper use of a prism is important when estimating basal area for a stand.



The trees in the fixed prism plot on the left are both "in," meaning they are counted and will be included in the BA estimate for the stand. On the right, the trees are too far away from the plot centre and show an offset image, meaning that they are "out." They will not be included in the estimate of basal area.

Although the DMD may at first appear complicated, its usage can be simplified to easily provide a measure of stocking. Where your stand "fits" on the graph will immediately tell you if it needs thinning and if so, how many trees need to be thinned.

DMDs can also be used to predict future thinning needs.



Density Management Diagram (DMD)

- ► DMD diagrams vary according to species and whether stands are natural or planted
- ► from your inventory, you'll only need to calculate average diameter and number of trees per hectare to use the DMD
- ► where your woodland "plots" on the graph determines whether it needs thinning – the amount of thinning is determined by comparing what you have to what's recommended on the graph

THINNING METHODS		
	BASAL AREA REDUCTION	**DENSITY MANAGEMENT DIAGRAM**
ADVANTAGES	• More traditional method • Quick to estimate approximate harvest level	• Can be used for crop planning ○ determining when next harvest is recommended ○ determining next harvest levels • Easier to use in the field • Harvest level is easier to understand and implement • Species-specific – one DMD per species
DISADVANTAGES	• Requires stand inventory • Requires experience using a prism • Marking trees also requires a prism • Optimum BA is variable as stand changes	• Requires stand inventory – not available for all species • Newer method not as well-recognized • Requires use of a complicated graph • Requires more data collection

If your plantation is less than 1 hectare (2 ac), it may not be advisable to use a DMD or BAR to manage your plantation. Use the following guidelines for your management activities in smaller plantations.

✔ Never remove more than one-third of the stand at any one time – one tree in three.
✔ Harvest the poorer quality trees with the smallest crowns.
✔ Schedule harvests apart by a minimum of eight years.
✔ Monitor the growth of the remaining trees each year after the harvest.

BMPs FOR THINNING AND PRUNING YOUR PLANTATION

ASSESSING HOW MUCH TO THIN

The first step in managing your plantation is to determine density: is yours overstocked, understocked or appropriately stocked? If it's overstocked, thinning is recommended. If it's understocked or appropriately stocked, thinning is not needed at this time.

Unfortunately, the determination of stocking is not simply a matter of counting the number of trees per acre. Stocking is a comparison of what you have, to the desired level. One thousand Red Pine per acre means nothing unless you have an idea of the trees' diameter. If the 1000 trees/ac (or 2500 trees/ha) have an average diameter of:

- ▶ 10 cm (4 in.) – the plantation is understocked
- ▶ 12.5 cm (5 in.) – the plantation is appropriately stocked
- ▶ 15 cm (6 in.) – the plantation is overstocked.

If market conditions are poor, you might want to consider delaying thinning operations until prices improve. However, long delays are not recommended because they can negatively impact tree growth, quality and potential.

FOUR STEPS TO DETERMINING HOW MANY TREES TO THIN

1. GATHER THE APPROPRIATE INFORMATION	• management history
	• past harvesting records
	• age of plantation
	• is there a market for plantation products?
	• check with local saw mills and pulp mills
	• contact forestry agencies for advice:
	  ○ Ontario Woodlot Association
	  ○ Ontario Ministry of Natural Resources
	  ○ private consultants
	• area of plantation
	• opportunity to coordinate harvest with neighbours

2. CONDUCT AN INVENTORY OF THE PLANTATION	• see pages 49–50 • collect the forest information necessary for the management system you have chosen
3. DETERMINE WHICH MANAGEMENT SYSTEM YOU ARE GOING TO USE	• Basal Area Reduction (BAR) – requires a prism and an understanding of basal area • Density Management Diagrams (DMD) – requires average diameter and tree density (trees/ha)
4. COMPARE YOUR RESULTS TO WHAT IS RECOMMENDED	• site of harvest is determined by comparing your *stand density* to recommended or ideal levels • thinning recommendations are provided in either stems/ha (DMD) or basal area (BAR) • recommended stocking levels are difficult to determine and beyond the scope of this manual; seek additional information before proceeding

White Pine plantation.

Special applications – according to plantation type

White Pine

- Start first thinnings when average diameter is 13 centimetres (5 in.), between 20 and 30 years of age.
- Be systematic with first thinning to provide access.
- Thin selectively and from below during subsequent thinnings, especially if there is weevil damage (30–50% of stems/row) and poor uniformity. The proportion removed should be lowered if weevil is present: this will provide more shade for residual trees and deter weevil infestation.
- Understand that first thinning may be pre-commercial or break-even, but will enhance the quality and value of the residual stand.
- Prune 125–150 White Pine crop trees per acre that are destined to remain until final harvest.

Mixedwoods

- Remember that the greater the number of species, the greater the variation in growth patterns.
- Make your first-access thinning in a row with poor performance and poor value (e.g., slow-growing Spruce or Cedar) if timber production is the long-term goal and species are similar within row.
- Manage similar to natural mixedwood stands during successive thinnings for timber – with emphasis on crop tree release – based on performance, condition, potential, value and density.

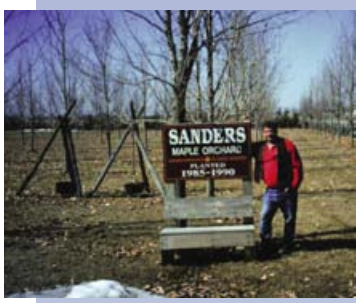
Sugar Maple plantation.

Hardwoods

- You must first select and prune crop trees.
- For stands with several species, choose which species should be favoured.
- Explore forest farming options.
- As the trees mature to crown closure, treat the stand like an even-aged natural polewood stand. Release crop trees by removing suppressed, defective and forked trees. Use thinning materials for fuelwood. Leave smaller material in piles for wildlife.
- Manage coppice regeneration for the more valuable trees.
- Prune veneer quality stems between thinnings, while maintaining proper crown ratios (40–60%).

Where harvestable volumes of conifer are low, it may be economically advantageous to coordinate the harvest with neighbours.

Maple plantations



Maple plantation.

- ▶ Until crown closure, control perennial grass and weeds that compete for light, space, moisture and nutrients with the young Maple trees until crown closure.
- ▶ Refill large gaps with large transplanted stock.
- ▶ Select crop trees that have large healthy crowns and no major defects.
- ▶ Prune to make the orchard trees structurally strong and at less risk of damage from wind and other damaging agents.
- ▶ Aim for approximately 250 crop trees of 15–25 cm DBH per hectare (100 crop trees of 6–10 in. DBH/ac) with a spacing of one tree every 6–7.6 metres (20–25 ft).

Energy plantations

- ▶ Design Hybrid Poplar or other fast-growing hardwood plantations with production objectives in mind.
- ▶ Be advised that Willow plantings are based on extremely high densities of 110,000 trees per hectare (43,560 trees/ ac) and 1-year rotations. Some Willow plantings are arranged in double-row mechanical plantings of 15,300 trees per hectare (6,200 trees/ac) with the expectation of mechanical harvest on 3- to 4-year coppice cycles.
- ▶ Focus on weed control and creating improved site conditions through fertilization and irrigation.
- ▶ Harvest during the dormant (winter) season. Winter harvesting ensures that the ground is hard and trafficable, and does not interfere with normal farm harvesting operations in the summer and autumn.
- ▶ Stockpile winter-harvested material (which is immediately chipped) for use throughout the year.

Ideal harvest equipment for energy plantations would be:

- ▶ continuous-travel feller/chipper, combined primary/secondary chip transport, and separation of clean chips from residues
- ▶ continuous-travel feller/loader, combined primary/ secondary transport of whole trees, delimbing/ debarking, and chipping.

Both systems could be used to produce either pulp chips or, by eliminating the separation step (and chipping in the second tree system), whole-tree chips or trees for energy.

Some industrial growers are diversifying their management of Poplar to grow sawlogs for plywood based on 10–20 year rotations – using cull materials for chipped biomass for energy.

Hybrid Poplar plantation for energy.

Tree marking is a way of ensuring that the right trees are cut and can help prevent possible harvesting errors such as over- or under-harvesting.

MARKING YOUR PLANTATION

Once you know how many trees need to be thinned, the next step is choosing which trees to take and which ones to leave for future thinning.

✔ **Choose the poorest quality trees first.** Leave the best quality trees for last.

✔ **Mark unacceptable growing stock (UGS) trees that:**

- ► have poor form
- ► have smaller crowns
- ► are damaged or diseased
- ► are smaller than average in diameter
- ► are immediately adjacent to an obvious crop tree.

Crop tree left until cycle of cutting.

Poor quality tree removed during thinning.

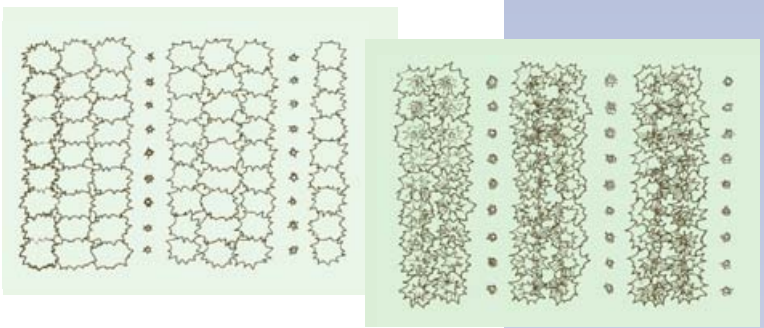
✔ **Leave acceptable growing stock (AGS) or crop trees, which are:**

- ► straight
- ► defect- and disease-free
- ► well-spaced from other crop trees
- ► sometimes marked with a different colour (usually blue) of paint.

✔ **Remove entire rows of trees and some of the poorest quality trees in the remaining rows during first thinnings:**

- ▸ allows for easier access to the stand
- ▸ usually one row in four (25%) or one row in three (33%)
- ▸ individual trees will be selected for removal during subsequent thinnings.

Removing one out of every 3–4 rows leaves room for crop trees to grow and allows for future equipment access into the stand. In most cases, some poor quality trees are selected and removed from the remaining rows.



Don't forget to:

✔ **Hire a certified tree marker who is experienced in marking plantations:**

- ▸ the Ministry of Natural Resources offers a training program for tree markers as well as an introductory course for landowners
- ▸ certified tree markers have passed a competency exam.

✔ **Operate safely:**

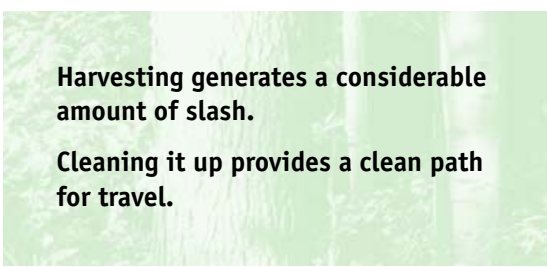
- ▸ never work alone
- ▸ rest when tired
- ▸ take a chainsaw safety course
- ▸ let other people know where you are working.

✔ **Hire a reputable logger to harvest your trees:**

- ▸ sign a contract listing obligations, payment schedules (in advance) and expectations
- ▸ check references and visit previously harvested sites.

✔ **Deal with the slash:**

- ▸ cut it down as low as possible (less than 1 metre or 40 in.) to facilitate decay and lessen the fire hazard
- ▸ if you're harvesting your own trees, work from the back of the plantation out to provide a clean unencumbered path for tree removal.



Harvesting generates a considerable amount of slash.

Cleaning it up provides a clean path for travel.

BMPs FOR MAINTAINING YOUR PLANTATION BETWEEN THINNINGS

Sawflys can be a serious pest in young conifer plantations. Regular monitoring can identify a future problem early and may help you reduce the potential impact of an outbreak.

Most plantations will require some form of maintenance between thinnings. Maintenance activities are a way of helping protect your investment from loss, or from events that may lower the value of living trees.

Monitoring – impacts from stressors like insect attack and Beaver-related flooding can often be lessened through early detection.

✔ Check your plantation for problems on a regular basis.

✔ Keep a record of your observations – this can be helpful in future years.

✔ Address any problems as necessary.

Cleaning – a clean plantation clear of debris looks better and is at less risk of insect infestation and fire.

✔ Cut fallen trees and slash down as close to the ground as possible (90 cm or 36 in. or less) to speed up the decomposition process and reduce the fire hazard.

✔ Cut any trees that pose a threat to safety.

Pruning – pruning the lower limbs from the trees in your plantation can provide significant benefits including:

► increased log grade and value of future harvests – applies primarily to White Pine and Red Pine grown for poles

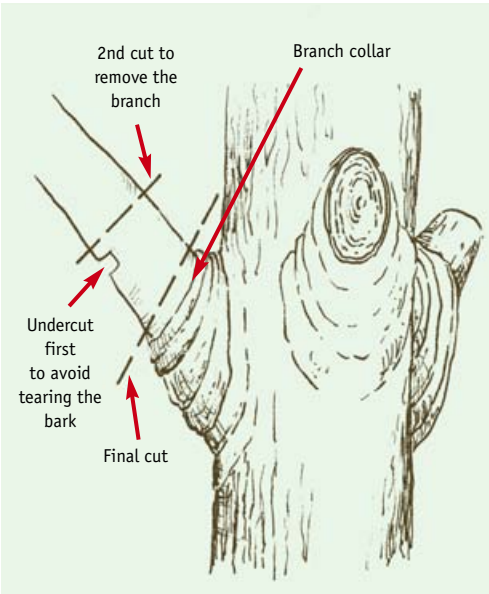
► reduced fire risk

► lowered incidence of White Pine Blister Rust infection – pruning opens the stand up, reducing the high humidity that encourages the disease.

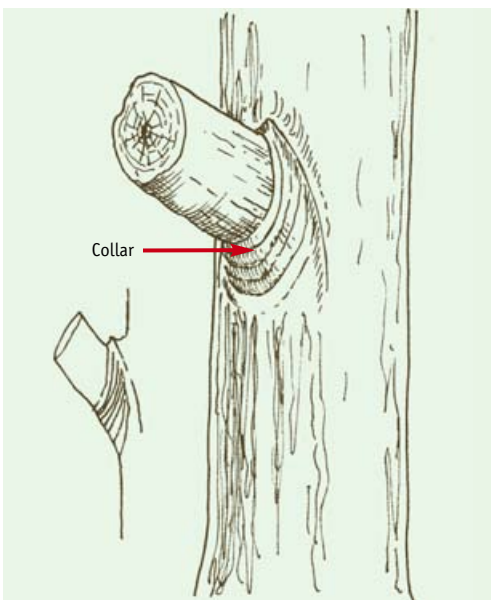
✔ Remove lower branches to create safer conditions for working in the plantation.

Before you start, carefully evaluate the cost versus the benefit of pruning. In some cases, pruning may only provide an economic benefit to the log buyer or the person retailing the finished product. There is no economic reason to prune Spruce at this time.

Pruning poles can help you reach higher branches.



Pruning should be done carefully to ensure that you don't damage the main stem. Damage creates entryways for insects and diseases.

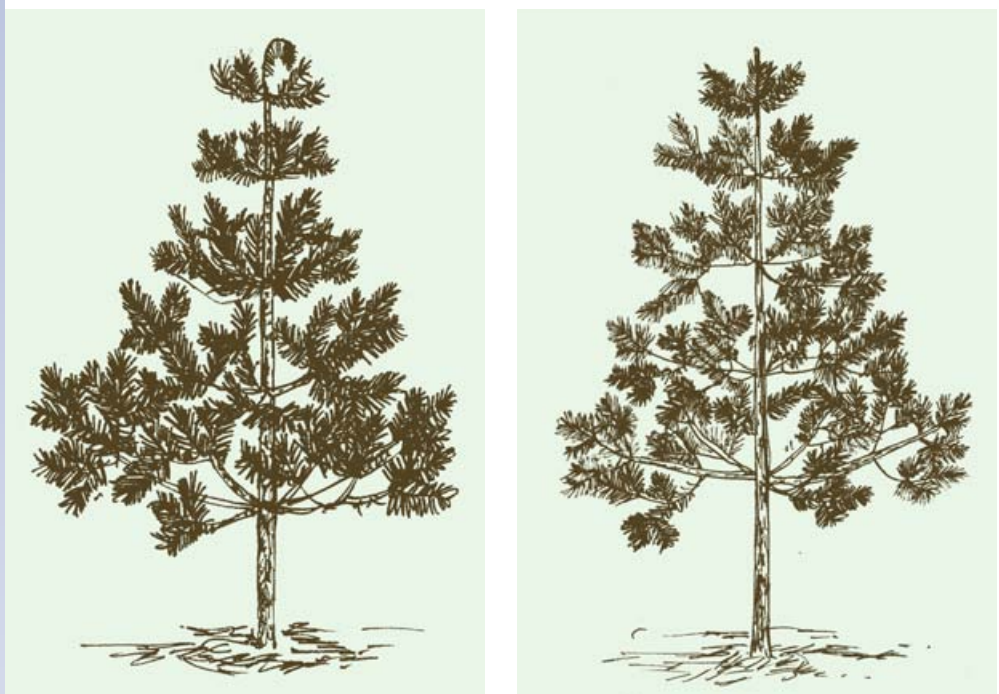


Improperly pruned branches will cause defects that will reduce your merchantable volume at harvest.

Poor pruning habits lead to improper recovery. Poorly recovered stems can act as pathways for insects and disease.

BMPs for pruning plantations

✔ Prune near the collar (but not the collar itself); don't leave branch stubs.
✔ Leave at least two-thirds of the live crown intact.
✔ Prune up to a height of 5 metres (17 ft).
✔ Prune only crop trees and those along pathways and travel corridors.
✔ Prune as soon as possible after thinning to capitalize on the increase rate of growth
  ► ideally, stem diameters will be between 15 and 20 cm (6–8 in.)
✔ Prune when the tree is not actively growing – fall, winter.



White Pine Weevil is a serious pest of young White Pine trees, especially in understocked plantations. Larvae tunnel down the leader and create a characteristic "hook" at the top of the tree. Corrective pruning of the dead leader and all but one of the side laterals can help improve the future quality of the impacted tree. White Pine planted with a cover crop usually suffers less Weevil damage. Closer spacing in White Pine may help to deter Weevil.

White Pine Blister Rust is spread though spores that enter a healthy tree through the needles. Infected branches eventually die and can often be seen for some distance. These branches can be pruned off before the fungus travels to the main stem.

BMPs FOR HARVESTING YOUR PLANTATION

Harvesting and selling standing timber can be a lot of work that many landowners are not prepared to do themselves. A landowner in eastern Ontario sought independent advice on what to do with his 25-year-old Red Pine plantation that had never been thinned. The company he contacted was a reputable one with many years of experience managing Pine stands. They sent out a forester who reviewed the landowner's plan with him.

The company had three economic criteria to be met before they would send out their tree-harvesting machinery.

1. **Good access to the stand. This was no problem as this stand was just off the main road.**
2. **Sufficient volume per hectare. They wanted a minimum BA of 40 m^2/ha (175 ft^2/ac) with an average diameter of between 16 and 25 cm (6–10 in.). This was no problem: the stand was at 43 m^2/ha (190 ft^2/ac) with an average diameter of 18 cm (7.2 in.).**
3. **Sufficient stand size (which is somewhat related to the quality of the product). In this case, the landowner only had 4.5 hectares (11 ac) of plantation so the company would not move their equipment the 100 km due to high operating costs.**

The landowner still ended up having the company harvest his trees because he was able to recruit two of his neighbours into thinning their plantations as well. The company did a very good job and the stands are better for it. The landowners were satisfied and they will contact the company again in 8to 10 years when the plantation needs to be thinned again.

Specialized machinery may be required to thin dense plantations.

SALE OF STANDING TIMBER CONTRACT

This contract entered into this _____ day of _____ 2007,

between _____
Of (Seller Address) _____
Hereinafter called the Seller,

and Purchaser _____
Of (Purchaser Address) _____
Hereinafter called the Purchaser.

DESCRIPTION OF SALE AREA

Lot(s): _____ Concession(s): _____
Township: _____ Area: hectare / acre _____
County or Regional Municipality:_____

Now therefore this contract witnesseth:
The Purchaser agrees to pay to the Seller the following amounts for all sawlog quality trees designated for harvest, under the conditions set forth in this contract:

Species	Timber: Price m^3/ fbm	Fuelwood/Pulp: Price m^3/ fbm

and, pay to the Seller the following amounts for all pulpwood / firewood trees designated for harvest, under the conditions set forth in this contract as specified above.

The Purchaser agrees to pay to the Seller ($ ____), by certified cheque or money order, as down payment upon the signing of this agreement, and the balance of the purchase price, $____ , shall be paid to the Seller, by certified cheque or money order, within ____ calendar days of the signing of this agreement or prior to the commencement of logging operations, whichever comes first.

(1) All marked trees, designated trees, or trees for sale, harvest, or felling, referred to in this contract have been marked.

(2) All trees of sawlog quality, which are designated for cutting, have been marked with yellow dot(s) at or about eye level and below stump height.

(3) All trees of fuelwood quality, which are designated for cutting, have been marked with yellow slash(es) at or about eye level and below stump height.

Signed in duplicate this _____ day of _____ 2007

(Witness for the Purchaser) _____ (Purchaser) _____
(Address/ Phone Number) _____ (Address/Phone Number) _____
(Witness for the Seller) _____ (Seller) _____
(Address/ Phone Number) _____ (Address/Phone Number) _____

A timber sale agreement would show how to best market your timber as well as offer legal protection from unscrupulous loggers. The very fact of having a contract tends to discourage these types of loggers from bidding on a timber sale.

BMPs FOR OTHER WOODLANDS

RIPARIAN WOODLANDS

FUNCTIONS AND COVER TYPES

Other woodland types are worthy of your attention and protection, specifically: riparian areas (alongside streams and other water bodies), wetland woodlots and treed fencerows. While they may not be as financially rewarding in the short-term, these areas are rich in environmental benefits, such as protecting water quality, providing wildlife habitat, sheltering livestock, reducing wind erosion – and simply providing aesthetic beauty.

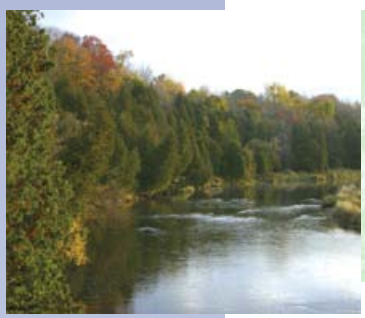
Riparian woodlands cover ravine slopes, banks, shores and wetlands. They perform the same functions as most woodlands in that they:

- ▶ protect soil and water quality
- ▶ provide habitat and woodland products.

In fact, riparian woodlands perform these functions more effectively than other woodland types assuming they are:

- ▶ extensive in size
- ▶ contiguous in shape, and
- ▶ relatively undisturbed.

Riparian woodlands are very productive sites and can produce high quality forest products.



Riparian woodlands are generally more fragile than most upland woodlands – often on sloping lands, on shallow or erodible soils, and directly adjacent to surface waters. Care must be taken when managing these areas to minimize damage.

Let's look more specifically at the functions of riparian woodlands.

Streambank and streambed protection

- Tree roots form living gabion baskets around soil materials in banks and shores – reducing erosion and sediment loss without interfering with natural channel process (meandering and bank shaping).
- Trees improve the efficiency of sediment transport in the channel by narrowing it.
- Trees and branches that fall in watercourses help form riffles, pools and meanders, and improve aquatic habitat.

Riparian forests filter and absorb dissolved nutrients from groundwater that enters watercourses in the form of baseflow.

Water quality

- Woodlands – both the trees and understory vegetation – filter sediment and other contaminants from runoff.
- Years of root growth and organic matter additions increase infiltration rates. More runoff water and the materials it carries are filtered through riparian soils.
- Baseflow, or groundwater moving on a downslope gradient, carries nutrients (such as nitrates) in solution. Woodland plants are particularly adept at using these nutrients before the groundwater reaches surface water.
- High organic matter levels and diverse soil life help to biologically and chemically alter contaminants into living tissue or less harmful forms.

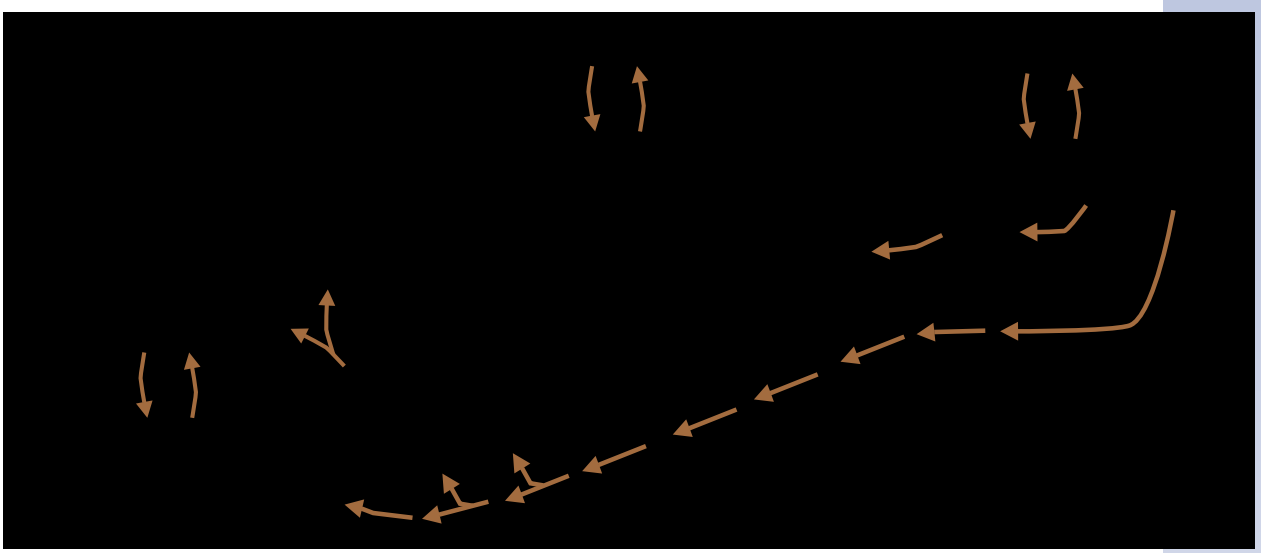
Fish and wildlife habitat

- Surface waters shaded by riparian woodlands provide cool and cold fish habitats.
- Leaves and other organic debris feed aquatic insects as part of the food chain in aquatic environments.
- Fallen trees and branches provide cover for fish and other aquatic animals.
- Riparian woodlands provide habitat needs – space, cover, food and water – for most mammals, birds, reptiles, amphibians and insects that live in Ontario.
- Riparian woodlands are important corridors for wildlife travel between natural areas.

Deer yard and overwinter in treed stream bottomlands.

Other environmental functions

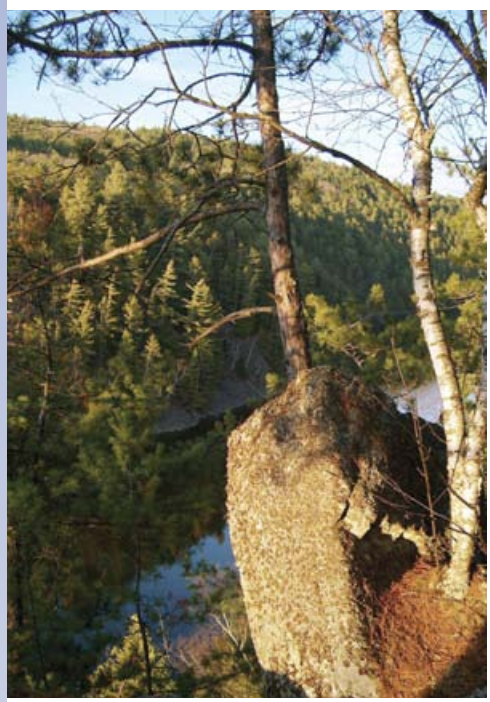
- BMPs for riparian woodlands are excellent for conserving soil. Buffers, berms and strip-cropping can reduce runoff and control erosion.
- Trees and shrubs are efficient at fixing carbon (CO_2) from the atmosphere to form wood and woodland soil organic matter. By means of nutrient uptake, they also prevent dissolved nitrate (NO_3^-) from turning into nitrous oxide (N_20), a harmful greenhouse gas.
- Riparian woodlands help manage water supply by slowing snowmelt and runoff as well as increasing water storage in woodland soils.



Riparian forests reduce agriculture's impact on climate change. Plants and soils sequester some key greenhouse gases, such as carbon dioxide. Methane can also be fixed by riparian soils. Emissions of nitrous oxide can be reduced when riparian vegetation intercepts cropland nitrates and ammonium as they move with groundwater to watercourses.

Other functions

- Riparian woodlands add beauty and diversity to the rural landscape – good for quality of life and the value of real estate and tourism.
- Riparian woodlands provide diverse settings for recreational activities such as hunting, fishing, hiking and trail use.
- Woodland products such as fuelwood, timber, maple products and alternative products can diversify farm and rural property income.



It is hard to place a dollar value on the aesthetic beauty of mature riparian woodlands.

FOUR RIPARIAN WOODLAND COVER TYPES

TYPE	DESCRIPTION	DOMINANT TREE SPECIES
UPLAND HARDWOODS	• Similar to non-riparian hardwood woodlots • Suited to selection management • Prone to erosion on steep slopes	• Sugar Maple, Beech, White Ash, Hickory, Ash, Oak, Black Cherry, Basswood (south) • Poplar–Birch (north)
UPLAND MIXEDWOODS	• Diverse habitats important to numerous wildlife • Selection management is most suitable • Difficult to keep mixedwood components on some sites	• Hemlock–White Pine–Sugar Maple; White Pine–Red Oak (south) • White Birch–Poplar–White Spruce (north)
LOWLAND HARDWOODS	• Level to hummocky topography • Temporary pools hold floodwaters, thereby reducing flooding and windthrow	• Silver Maple; Soft Maple–Green Ash; Bur Oak–Shagbark Hickory–White Ash (south); • Black Ash; Balsam Poplar–White Birch (north)
LOWLAND MIXEDWOODS	• Located in floodplain and adjacent to riparian woodlands • Organic surface soil layer is common • Minimal understory vegetation prone to flooding and windthrow	• Cedar–Tamarack–Balsam Fir–Birch–Poplar (north and south) • Red Maple–Hemlock–White Pine–Yellow Birch (south)

Riparian forests store floodwaters and runoff – helping watercourses maintain flow throughout the year.

BMPs FOR RIPARIAN WOODLANDS

✔ Develop a plan for your riparian woodland. Inventory your forest resources and site limitations. Seek technical assistance where necessary. Schedule your activities according to your goals and season. Harvest with water quality in mind, and monitor sensitive areas.

✔ Leave it! Not all riparian forests need management. Some lowland forests and upland forests on very shallow or steep sites may be better off left alone. At the very least, consider a no-harvest zone adjacent to your watercourse, wetland or lake. With no effort at all, important habitats can be protected.

In the treed buffer design, each zone has its distinct place and function. The trees in Zone 1 shade the water and stabilize the banks. Zone 2 soils and vegetation help to filter sediments, and promote infiltration and floodwater storage. Zone 3 filters cropland runoff and serves as a field buffer.

✔ Don't use them as dumps. Riparian woodlands can be inaccessible or hidden from view. In the past, they've been used as "ideal" dump sites. Landfills are intended for the disposal of solid wastes. Use them!

✔ Match forest management system to cover type. Use selection management systems to promote shade-tolerant trees in riparian woodlands. Other systems (e.g., shelterwood) can work for other species (e.g., Pine and Spruce) when not on fragile lands.

✔ Introduce harvesting equipment when soils are dry or frozen to minimize site damage and erosion. Use horses or equipment with high-flotation tires on sensitive sites. Cables and winches should be used to harvest high value timber on severe slopes.

Conifers in riparian woodlands provide excellent cover for wildlife.

Set landings away from water to minimize the impact of logging operations.

- ✔ Harvest to reduce felling and skidding damage to residual stand.
- ✔ Design roads and skid trails to minimize damage.
  - ▶ avoid wetlands and watercourses
  - ▶ follow contours where possible
  - ▶ rehabilitate damaged areas caused by skidding and hauling
- ✔ Set landings as far away as possible from water.
- ✔ Create crossings to eliminate any sediment loadings and washouts. Use cull trees as bridges and silt fences to avoid siltation. Reduce the number of crossings.
- ✔ Avoid handling hazardous products in the riparian area. Fuel up and lubricate harvest equipment away from water.
- ✔ Time operations to minimize wildlife disturbance (e.g., avoid nesting periods).
- ✔ Leave 4–6 snag trees per hectare (10–15 ac) and fallen logs for wildlife habitat.
- ✔ Maintain 1–2 cavity trees per hectare (2–5 ac) in remaining stand for cavity-dwelling birds and mammals.
- ✔ Leave rockpiles alone and create piles of treetops for cover.
- ✔ Create openings or plant nut (e.g., Beech, Oak, Hickory) and catkin trees (e.g., Birch) in upland areas.
- ✔ Plant additional trees on adjacent fragile and marginal lands to expand the width and area of the riparian woodland.
- ✔ Keep treed fencerows and plant windbreaks to connect other natural areas (e.g., woodlands, wetlands and ponds) to riparian woodland area.

Keep cavity trees for nesting wildlife in riparian forests.

Use treed buffer strips and treed fencerows to connect woodlots with wetlands and riparian areas.

WOODED WETLANDS

Wetlands can be found throughout farm landscapes in Ontario. In the south, wetlands are most often marshes and swamps. In the north, wetlands tend to be bogs and to a lesser extent fens.

Wetlands store water, keep water tables high, remove nutrients and provide habitat. They should be protected and managed with extreme caution.

Shallow water tables and flooding lead to an accumulation of downed and dead woody materials on the forest floor. This is critical habitat for amphibians and reptiles.

BMPs FOR WOODED WETLANDS

Before you undertake any work, familiarize yourself with four key principles for managing wooded wetlands.

1. Avoid physical damage to soils, waterways and vegetation.
2. Prevent any deleterious substances from entering the wetland.
3. Seek approvals and permits if you plan any changes.
4. Harvest on a sustainable basis to ensure a long-term supply with minimal impact on habitat.

Riparian wetlands store and release floodwaters.

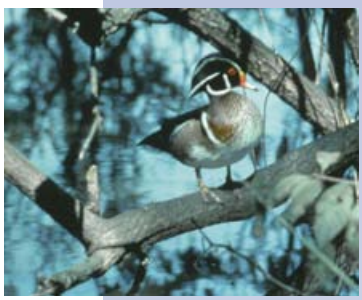
Wetland management

✔ Exclude livestock from wetlands. If drinking water is needed, install an alternative watering device. Don't draw down water during critical times, such as nesting.

✔ Leave it alone: just keeping it is a BMP.

✔ Establish upland buffers: wider is better. A 16-metre (52-ft) buffer is optimal.

✔ Don't dump in wetlands.



Riparian swamps are important nesting habitat for waterfowl.

Wetland timber harvests

✔ Plan your operation:

- ▶ do an inventory, and identify sensitive features
- ▶ seek professional assistance for your timber harvest
- ▶ time operation to reduce impact.

✔ Minimize area and duration of disturbance.

✔ Avoid working during high-flow periods.

✔ Use machinery in winter and only when soil conditions are frozen.

✔ Use proper crossing techniques to avoid damaging and blocking the flow of any watercourses in wetlands.

✔ Do not create conditions that impede wildlife movement.

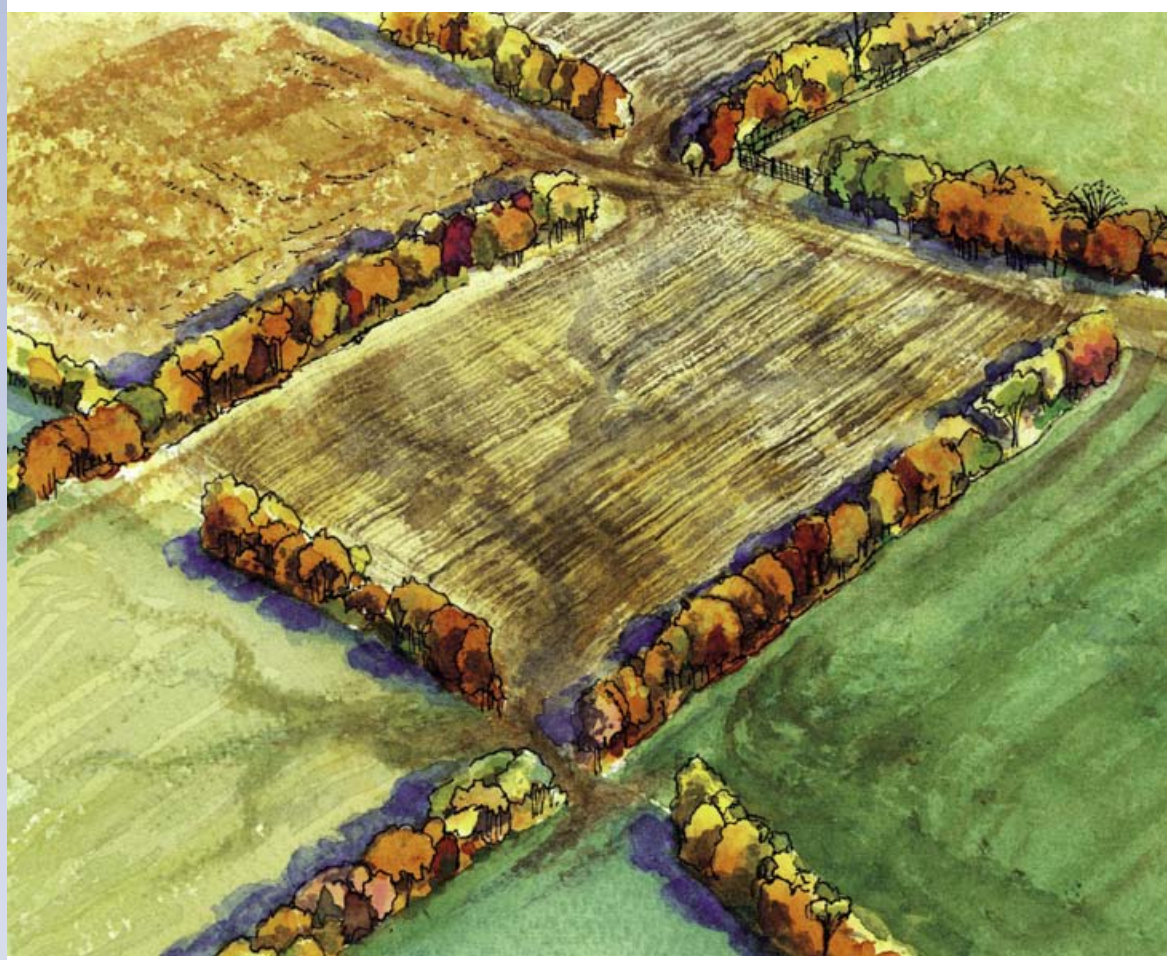
✔ Do not clearcut vegetation. Use a management-free zone around sensitive areas.

For wetland restoration techniques, please see the BMP book *Fish and Wildlife Habitat Management.*

Many Deer yards in southern Ontario are found in riparian swamps.

TREED FENCEROWS

Field management in Ontario has resulted in the removal of many kilometres of treed fencerows. While their removal made possible the use of larger farm machinery and extended crop area, the many benefits of treed fencerows were lost.



Treed fencerows are prevalent in eastern and central Ontario. Here, producers use them for fuelwood, maple syrup production, and as protection for grazing livestock.

Treed fencerows can be managed for wind protection and fuelwood.

Treed fencerows are common in certain parts of the province. Most were established naturally, and contain species of trees and shrubs that can contribute to the productivity, diversity and income of farms.

Treed fencerows commonly follow the boundaries of farm fields, roadsides and property boundaries. Open spaces within the fencerow can be planted with local trees and shrubs.

They serve as natural shelterbelts and windbreaks by reducing the effects of wind erosion, water erosion and runoff. Treed fencerows are also important travel corridors for wildlife: the wider and more diverse the better. Often overlooked, treed fencerows can produce woodland crops and products for sale or in-kind use on the farm. Treed fencerows are a source of:

- fuelwood
- timber
- fenceposts
- maple syrup
- shelter for livestock
- habitat for insect-eating birds
- nectar and habitat for pollinators.

Roadside Maples and other hardwoods can still be seen in rural Ontario.

BMPs FOR TREED FENCEROWS

- ✔ Prune branches that interfere with field operations, but keep fencerow area as wide as possible.
- ✔ Select and prune crop trees.
- ✔ Remove dead limbs and thin poor quality trees for fuelwood. Leave roost trees for raptors.
- ✔ Manage coppices from stumps.
- ✔ Consider pollard trees for sustained fuelwood harvests.
- ✔ Promote sugar-producing trees if Maple is dominant species.
- ✔ Plant or transplant valuable hardwoods for timber production.
- ✔ Plant Sugar and Black Maples for sugar production.
- ✔ Encourage Basswood and other important nectar species.
- ✔ Leave woody plants, as well as snags, downed and dead wood, cavities and mast trees. They're all important for wildlife.
- ✔ Leave piles of stones and branches for wildlife.

Treed fencerows provide critical habitat for beneficial wildlife such as Weasels and other predators.

BMPs FOR WOODLOT HARVEST

PLANNING A HARVEST

For more information, or to receive a copy of the handbook *A Landowner's Guide to Selling Standing Timber,* contact the Ontario Woodlot Association at 888-791-1103.

A well-managed woodlot should be considered an investment – both for your own benefit and as a legacy for future generations.

Planning properly for a harvest will help you:

- ▸ maximize revenue from your harvest
- ▸ maximize future profit
- ▸ protect and enhance natural features such as wildlife habitat and water resources
- ▸ improve other forest values such as fuelwood and maple syrup production
- ▸ create or enhance recreation opportunities such as hiking and hunting
- ▸ comply with local regulations such as tree-cutting bylaws.

Before you sell

Your woodlot is a valuable asset. But it's not just timber. Consider everything it contains, including wildlife habitat, water resources, opportunities for recreation, and aesthetic values. Before you harvest, make sure your woodlot is protected!

- ✔ Do some research. If you are unfamiliar with the value of forest products such as veneer or sawlogs, take the time to do some basic research. How can you get a fair price if you don't know what the market is paying?
- ✔ Plan ahead. Take an inventory of your woodlot. Find out about the variety, age and number of trees growing on your land. Prepare a management plan. Whether you're harvesting for a source of revenue or for other objectives, you will benefit from advance planning.
- ✔ Decide which trees to harvest. Select and mark the trees that you plan to sell. Trees must be marked so that you can accurately compare bids from interested buyers. Keep in mind that it's in your best interest to have a healthy, productive woodlot after the harvest.
- ✔ Get more than one bid. Obtain bids from at least three different buyers to ensure that you receive fair value for your timber. A forestry consultant can help you with this.
- ✔ Ask for references and sign a contract. Check references to ensure that your buyer's previous customers were satisfied with the harvesting operation. Ensure you have a signed contract that protects your interests.
- ✔ Monitor the harvest. Spend some time in your woodlot during the harvesting operation to ensure that the work is done to your satisfaction.

Unless you are certified to mark trees, hire a forestry consultant to do this. Proper marking will make you money and protect your investment.

FOREST HARVEST BUSINESS PLANNING

Work with your consultant when reviewing bids for harvest.

So it's time to harvest. The woodland management plan has been prepared. The consultant has marked the woodlot and you're ready to sell your standing timber.

But before you plan the harvest, consider the next steps:

- ✔ Tally the marked trees. You need to know how many trees were marked by species to be able to follow up.
- ✔ Obtain an estimate of the harvest volume by species that you plan to sell. Make sure that you have this information by product type: how many veneer logs, sawlogs, cull trees etc. A summary of this information will help the bidding process and give you an estimate of the total value of the harvest.
- ✔ Firm up estimates after scaling. Remember that volume estimates of standing timber are estimates only. Logs at the landing are scaled or assessed to more precisely calculate the merchantable volume of each harvested log. Scaling accounts for but does not include bark and the proportion of the tree volume that is defective through rot, cavities, disease, etc.
- ✔ If you choose to market your own timber – standing or on the landing (after harvesting it yourself) – you can contact loggers, work with a forestry consultant or advertise through the Ontario Forestry Association's *Forest Products Marketing Bulletin* or the Ontario Woodlot Owners Association's *S&W Report*.

For a sample "Sale of Standing Timber Contract", see page 126.

- ✔ Determine the best way to sell your timber by talking to a forestry consultant. There are pros and cons to these approaches:
  - ▸ a lump sum bid – one offer for all products from the harvest (scaling of logs is not required for lump sum sales)
  - ▸ a scaled volume sale – the sale is based on agreed-to prices for the various classes of timber, such as veneer, No. 1 logs, etc.
  - ▸ a shared value sale – an agreed-to split with the contractor for the income received from the mill (e.g., 50–50% split).

Selling by scaled volume provides both buyer and seller with an accurate estimate of the total and type of merchantable volume for sale.

STANDING TIMBER VALUES ($ PER 1000 FOOT BOARD MEASURE*) FOR SAWLOGS BY REGION – 2006

SPECIES	EASTERN (LANARK – STORMONT)	NORTH CENTRAL (NORTH BAY – PEMBROKE)	SOUTHWESTERN (NIAGARA – LAMBTON)
BASSWOOD	100–250	90–150	135–270
BLACK CHERRY	250–400	150–450	700–1100
HARD MAPLE	150–600	150–350	550–1200
RED OAK	200–500	100–200	400–600
WHITE ASH	100–150	75–150	180–400
WHITE PINE	75–200	100–200	90–225

Source: *Ontario Forest Products Marketing Bulletin,* July/Aug. 2006
* 1 fbm = 12 inches square and 1 inch thick

BMPs FOR HARVEST

Woodland harvest can be done by the owner or, in the case of selling standing timber, by the contractor.

✔ Before harvesting, be sure to consider:

- ► season of harvest and timing of operations to avoid damage
- ► access points to the woodlot and location of property boundaries
- ► compensation for damaged residual trees (with contractor)
- ► location of trails, roads and landings
- ► appropriate BMPs in sensitive areas such as streams and wetlands.

Well-scheduled harvests can help prevent irreparable damage – especially on fragile sites such as lowland hardwoods.

Roads and crossings

✔ Build roads on well-drained soils and sites (e.g. benches) to avoid rutting and compaction.

✔ Avoid wetlands and streams wherever possible.

✔ If you must cross streams:

- ► make few crossings
- ► leave buffer vegetation intact
- ► cross at right angles
- ► properly size and place culverts
- ► consider use of portable bridges – they protect site and reduce machine travel and wear.

Damage avoidance

Timing

✔ Harvest in frozen conditions or in late summer/early fall. Special care must be taken during other times of the year. Horse logging is preferred when conditions are not dry.

✔ Avoid harvesting from spring to late July. The risk of bark damage is highest at this time.

Communication

✔ Talk about it. The best way to prevent misunderstandings is to articulate your expectations. Better still, put them in the contract.:

- ► skidders should ensure proper trail location, winch in tight areas, use bumper trees to protect residual crop trees on curves in skidding trails
- ► proper felling techniques avoid damage to residual trees, e.g., sequential felling (domino effect), and felling the trees so that the butt ends face the skid trail

✔ Monitor the harvest during and after with the forestry consultant and the logger.

Minimize harvest damage – hire a forestry consultant to monitor the harvest.

HEALTH AND SAFETY ISSUES WHEN HARVESTING WOODLOTS

Unsafe practices while felling, trimming trees, hauling logs and cutting wood can have tragic consequences. Many serious injuries and fatalities can be prevented when safe practices are followed.

Whether you're working in your woodlot, your fields or your barn, agricultural safety begins with attitude. A safe, well-organized farming operation is also a productive and profitable one. Maintaining equipment and facilities and being careful in production make good business sense. Unsafe practices have led to needless accidents.

The act of cutting and skidding wood falls under the regulations for forestry in the Occupational Health and Safety Act. Individuals cutting wood must be certified and competent in chainsaw use. Basically, while logging is going on, this portion of your farm becomes a forestry workplace, and is regulated.

Safe work practices begin with an understanding of the hazards. To assist farmers in developing safety programs for their operation and employees, the Farm Safety Association offers on-site training sessions, workplace inspections, and self-audits for the farm (Agricultural Safety Audit Program or ASAP). The Farm Safety Association has posted extensive resource materials at www.farmsafety.ca.

Another organization, the Ontario Forestry Safe Workplace Association, has information dealing with safety in woodcutting as well as a listing of trainers for chainsaw certification. This can be accessed at their website, www.ofswa.on.ca. Play it safe: take the chainsaw operator's safety course.

Many so-called accidents are avoidable. Perhaps the most important BMP is to work safely, with a full understanding of potential hazards. Never work alone.

Harvesting standing timber presents its own unique set of hazards. Know what these are before you start your chainsaw.

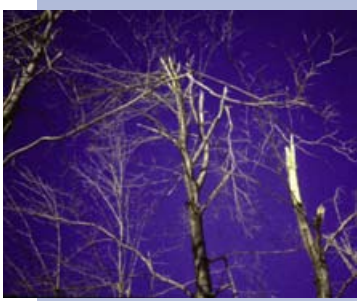
BMPs FOR FOREST HEALTH AND CONTINGENCY PLANNING

FOREST HEALTH

Knowing how your forest is doing may be as simple as monitoring or scouting it for obvious signs of problems. Scout your woodlands three or four times annually to check for degradation, unauthorized use, forest pests, and evidence of invasive species.

A forest will naturally cycle between healthy and unhealthy conditions over long periods of time. However, forests that are healthy now will be impacted by weather, insect and disease-related events, which will affect their overall health. Following through on these next guidelines will lessen the toll of unhealthy conditions.

- ✔ Ensure that your forest is well-managed and appropriately stocked.
- ✔ Promote a diversity of species and age classes.
- ✔ Walk through your forest regularly looking for potential health problems.
- ✔ Keep a record of your observations.
- ✔ Monitor for invasive species and take steps to control their populations.
- ✔ Learn more about insects and diseases that could impact your forest.
- ✔ Keep livestock out of the woodlot.
- ✔ Minimize damage from machinery.
- ✔ Consult an expert if you suspect you have a problem.



The 1998 ice storm in eastern Ontario caused widespread damage to forests throughout the affected area. Although it would have been impossible to account for this type of disaster in a management plan, woodlots that were well-managed before the ice storm tended to fare better than those that weren't.

In severe cases, a disruption of forest health may not allow it to recover to a healthier condition without some intervention. The spread of disease may cause such severe die-off of tolerant hardwoods that the forest stand structure will change due to such factors as greater light penetration to the forest floor. When this occurs, species composition changes toward more light-tolerant species that may hold less commercial value.

CASE STUDY

This landowner harvested part of his woodlot without using BMPs. Although he thought he was doing the right thing by logging in the winter and taking a mix of poor and high quality trees, he harvested more trees then he should have. By opening the stand up too much, his "understocked" woodlot was more vulnerable to wind-throw. The following spring, a strong windstorm uprooted many of the trees he had left. The composition of this woodlot is forever changed and it will take decades before it yields any more forest products.

Inappropriate harvesting can cause significant damage to residual trees.

CONTINGENCY PLANNING

Management planning has to be a fluid process, allowing periodic adjustments for unexpected events.

UNPLANNED EVENTS THAT AFFECT AGROFORESTRY MANAGEMENT

EVENT	IMPACT
SEVERE ICE STORMS	• Occur infrequently • Well-managed forests are generally in a better position to withstand the impacts of ice storms • Over-thinned and unthinned stands suffer the most
DROUGHT	• Can have both short- and long-term impacts on forest health • Moisture is the most limiting biological requirement
INSECT ATTACK	• Forests are often adapted to periodic insect defoliation • Invasive insects like the Gypsy Moth and Emerald Ash Borer can cause significant mortality, upsetting the natural balance of the woodlot • Native insects are a natural part of the life cycle of a forest – evaluate any risks and options when considering a spraying operation
FIRE	• Seldom a problem in southern Ontario forests • Conifer stands more susceptible than hardwoods • Fire breaks and access roads should be clearly identified in the management plan
INVASIVE PLANTS	• Can grow to dominate understory vegetation • Can exclude natural regeneration of native trees and plants • Can be very difficult to control – vulnerable areas require a specific preventive management strategy
WIND	• Can devastate small to large tracts of forest • Susceptibility to damage related to site – trees on shallow soils and shallow-rooted species

Trees that could be deemed a possible safety hazard should be removed during normal management activities.

If disaster strikes...

- **► assess safety risks and amount of damage to your woodlot**
- **► seek professional help and advice, if appropriate**
- **► cut unusable debris down to below knee level to avoid fuel buildup and enable regeneration.**

Extremely dry weather can cause a significant amount of stress and weaken the tree, making it more susceptible to other problems.

GLOSSARY

Abiotic – Non-living components of the environment, such as air, rocks, soil, water, peat, and plant litter.

Afforestation – Establishment of trees on an area that has lacked forest cover for a very long time (at least 50 years, according to the Kyoto Agreement definition).

Age class – Any interval into which the age range of trees, forests, stands, or forest types is divided for classification. Forest inventories commonly group trees into 20-year age classes.

AGS – Acceptable growing stock or crop trees, i.e., good quality trees with high potential value.

All-aged – All, or almost all, age classes of trees represented. Also called uneven-aged.

Basal area (BA) of a tree – The cross-sectional area of a tree (at chest height) usually expressed in square feet or square metres.

Of a forest or stand: the area in square metres per hectare or square feet per acre of the cross-section at chest height of all the trees.

Biomass – Weight (amount) of all organic matter in a given ecosystem. It also refers to plant material that can be burned as fuel.

Biotic – Living components of the environment or ecosystem (such as plants, animals, insects and fungi).

Board feet (foot) – Measurement term for lumber or timber. It's the amount of wood contained in a board 1 inch thick, 12 inches long, and 12 inches wide.

Cambium – Single layer of cells between the woody part of the tree and the bark. Division of these cells results in diameter growth of the tree through the formation of wood cells (xylem) and inner bark (phloem).

Carbon sequestration – Uptake and storage of carbon.

Carbonates – Free calcium carbonate in the soil profile. Can interfere with nutrient uptake for some species.

Climax forest – Forest community that represents the final stage of natural forest succession for its environment.

Codominant – In stands with a closed canopy, those trees whose crowns form the general level of the canopy and receive full light from above, but comparatively little from the sides.

Crop tree – Tree in a young stand or plantation selected to be carried through to maturity until an interim or final harvest. One of the better trees in the stand.

Crop tree selection – Selecting individual crop trees that exhibit desired characteristics (usually for maple sap or timber production). Crop trees are generally left for future use and not harvested at the time of selection.

Density – See stand density.

Diameter at breast height (DBH) – Stem diameter of a tree measured at breast height (1.30 m [4 ft] above ground level).

Diameter distribution – Ranges in tree sizes (diameters) representing stages in the development of a tree or stand.

Dominant – Trees with crowns extending above the general level of the canopy and receiving full light from above and partly from the side; taller than the average trees in the stand with well-developed crowns.

Early successional forest – Forest type characterized by fast-growing, shade-intolerant tree species.

Even-aged – Forest stand or forest type in which relatively small age differences (10–20 years) exist between individual trees. Even-aged stands are often the result of fire, a harvesting method such as clearcutting, the shelterwood method, or land abandonment.

Exotic species – Non-native species found in a given area as a direct or indirect result of human activity. Also refers to captive or free-ranging non-native animals.

Group selection – Selecting or clearing a number of trees in close proximity in order to create a small opening in the forest. Usually done to promote the establishment of mid-tolerant species.

Hybrid Poplar – Poplar trees selected or bred for rapid growth to produce fibre or wood products or act as a nurse crop.

Income in-kind – Measure of the value of agricultural commodities produced on farms and consumed by individuals living on these farm operations.

Invasive species – Harmful alien species whose introduction or spread threatens the environment, human health, and/or the economy.

Management prescription – Also known as silvicultural prescription of stand. A stand-specific operational plan that prescribes methods of harvest and renewal.

Marginal land – Agricultural land of limited potential productivity.

Moisture regime – Classification of the moisture available to trees throughout the growing system. There are four classes: dry, fresh, moist and wet.

Mottles – Rust-coloured spots in the soil profile, which mark the depth of the seasonal water table.

Pioneer species – Also see early successional forest. A tree species that is usually first to grow on a disturbed or open site.

Plantation – Forest crop established by artificial means, either by sowing or planting.

Reforestation – Natural or artificial restocking (i.e., planting, seeding) of an area with forest trees. Under the Kyoto Agreement, reforestation occurs when an area that has not been open for more than 50 years is returned to a forested state.

Riparian buffer strip – Buffer of trees and other vegetation between an agricultural area and a riparian feature (e.g., stream, wetland).

Sawlog – Log harvested for wood products – usually timber or lumber.

Silvics – Study of the life history and general characteristics of forest trees and stands.

Silviculture – Art and science of controlling the establishment, growth, composition, health and quality of forests and woodlands.

Silvipasture – Practice of growing trees with pasturing livestock.

Site preparation – Treatment of the soil and ground vegetation in preparation for planting.

Soil texture – Percentage of sand, silt and clay found in a particular soil.

Species composition – Percentage of each recognized tree species comprising the forest type based on the gross volume, the relative number of stems or the basal area per hectare or acre.

Stand – Community of trees sufficiently uniform in species composition, age, arrangement, and condition to be distinguishable as a group from the forest or other growth on the adjoining area, and thus forming a silvicultural or management entity.

Stand density – A quantitative measure of the amount of stocking in a forest area. Often described in terms of stems or basal area per hectare (or acre).

Succession – The natural and gradual replacement of one community of trees and plants by another.

Tree marking – A system of identifying specific trees in the forest. Trees are usually marked with different colours of paint depending on the type of tree identified. Trees are usually marked for removal as crop trees or as boundary trees.

Uneven-aged – All, or almost all, age classes of trees represented. Also called all-aged.

UGS – Undesirable growing stock, i.e., poor quality trees and trees with low potential value.

Wedge prism – Optical instrument used as an angle gauge consisting of a thin wedge of glass that establishes a fixed (critical) angle of projection in a fixed-radius sample plot.

Working group – Similar tree species associations commonly found in forest stands and grouped for the purpose of applying a common set of silvicultural treatments. Similar to forest cover type.

Agencies and Offices

Conservation Ontario
ph: 905-895-0716
email: info@conservationontario.ca
web: http://conservationontario.on.ca

Eastern Ontario Model Forest
ph: 613-258-8241
e-mail: modelforest@eomf.on.ca
web: www.eomf.on.ca

Landowner Resource Centre
ph: 1-800-267-3504
e-mail: info@lrconline.com
web: www.lrconline.com

Ontario Ministry of Agriculture, Food and Rural Affairs
Agricultural Information Contact Centre
ph: 1-877-424-1300
email: ag.info.omafra@ontario.ca
web: www.omafra.gov.on.ca

Ontario Ministry of Natural Resources
Natural Resources Information Centre
ph: 1-800-667-1940
email: mnr.nric.mnr@ontario.ca
web: www.mnr.gov.on.ca

Ontario Soil and Crop Improvement Association
ph: 1-800-265-9751
web: www.ontariosoilcrop.org

Ontario Woodlot Association
ph: 1-613-258-0110
e-mail: info@ont-woodlot-assoc.org
web: www.ont-woodlot-assoc.org

Canada

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Eastern Ontario Model Forest

Publications

BEST MANAGEMENT PRACTICES SERIES

Buffer Strips

Establishing Tree Cover

Farm Forestry and Habitat Management

Fish and Wildlife Habitat Management

EASTERN ONTARIO MODEL FOREST

A Guide to Improving and Maintaining Sugar Bush Health and Productivity

A True Picture: Taking Inventory of Your Woodlot

Choosing the Right Tree: A Landowner's Guide to Putting Down Roots

Design, Installation and Maintenance of Plastic Tubing Systems for Sap Collection in Sugar Bushes

Eastern Ontario Model Forest Code of Forestry Practice

ONTARIO MINISTRY OF NATURAL RESOURCES

Extension Notes Series (approximately 55 titles) – Landowner Resource Centre, Manotick, Ontario

Guide to Stewardship Planning for Natural Areas

Silvicultural Guide to Managing Southern Ontario Forest

MNR also has a series of guide books regarding forest practices to protect and improve wildlife habitat, watersheds, and other values. Please see the Publications section of their website.

ONTARIO SOIL AND CROP IMPROVEMENT ASSOCIATION

Ontario Environmental Farm Plan Workbook

ONTARIO WOODLOT ASSOCIATION

A Landowner's Guide to Selling Standing Timber

DISCLAIMER

This publication reflects the opinions of the contributing writers and/or editors, and is based on information available as of the publication date. It may not reflect the programs and policies of the supporting agencies. References to particular products should not be regarded as endorsements.

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