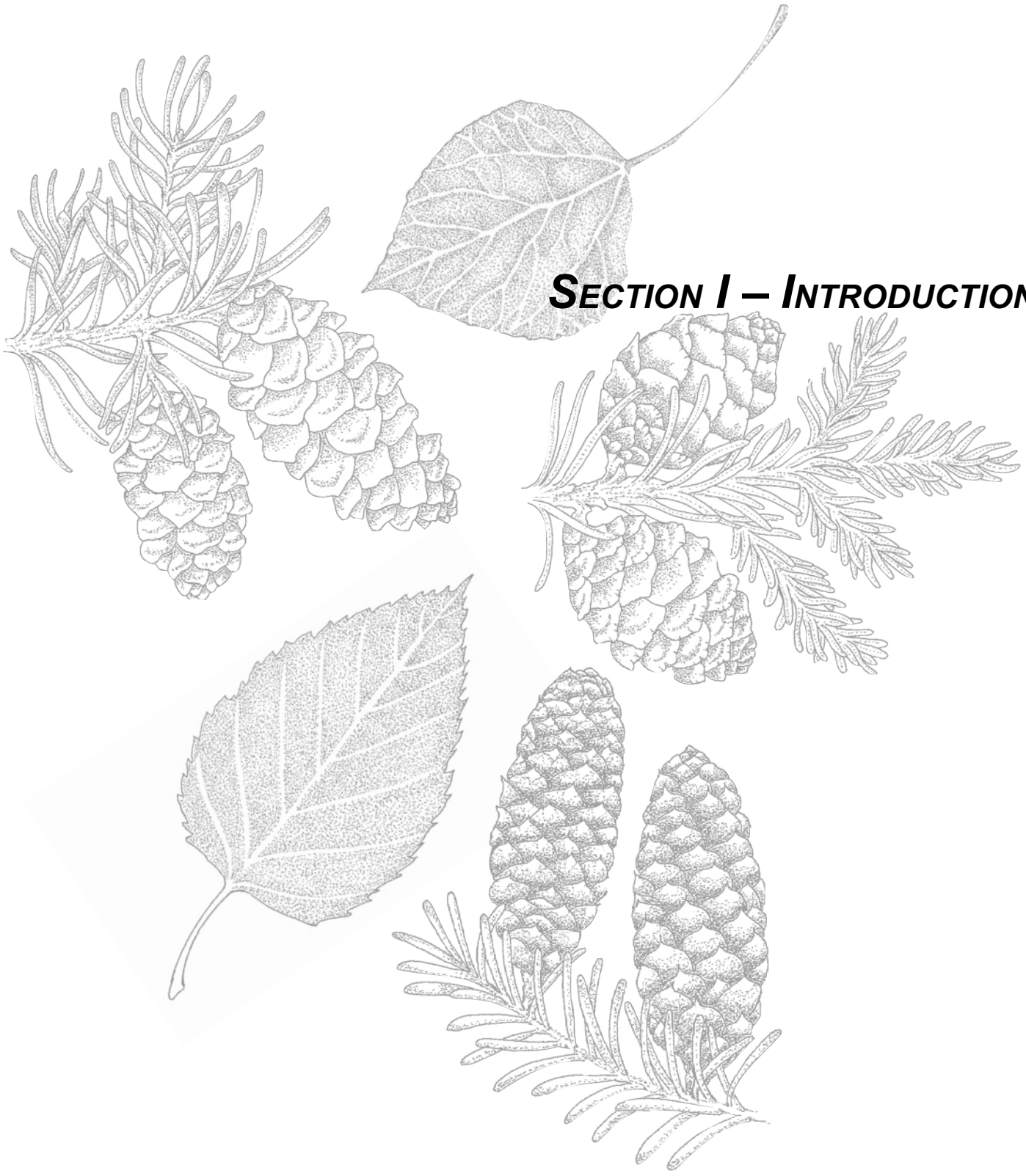


SECTION I – INTRODUCTION

Section I introduces the reader to the *Silviculture Guide to Managing Spruce, Fir, Birch, and Aspen Mixedwoods in Ontario's Boreal Forest* by presenting the philosophical, ecological, and legislative context for forest management in Ontario. This section establishes the ecological context used throughout the guide and defines boreal mixedwood sites and stands. The opportunities for, and benefits of, practicing intentional and proactive boreal mixedwood management are also given. As well, this section provides guidance for applying the guide's site- and species-based interpretive ecological and management information during the forest management planning process. Finally, this section outlines the legislative and policy framework for sustainable forest management in Ontario.

Setting the Ecological Context

Boreal mixedwoods are complex ecosystems that have developed over time in response to natural disturbances, site and soil conditions, species autecology and interactions, and cultural histories.

Traditionally the term "mixedwood" was based on the species composition of a stand at a fixed point in time (historically treated as an inventory issue) where both conifer and hardwood species were present (OMNR 1996). This inventory approach does not consider changes in species composition that may occur as a result of physical and biological factors acting on individual stems or species, or the relationship between species dominance, shade tolerance, and future stand compositions.

The boreal forest is a dynamic system where mixedwood stands are part of natural successional pathways. These pathways may be influenced by natural disturbances (e.g. fire, blowdown, insect infestations) or human intervention. In the absence of a stand-replacing disturbance (either natural or human-caused), and without subsequent human intervention, a stand generally succeeds from pioneer intolerant species in early stages, through the transition to mid-tolerant species at mid-stages, and ultimately to a complex mixture of predominantly tolerant species in later stages of succession.

What is a Boreal Mixedwood?

In Ontario, boreal mixedwood conditions have been defined by their site and stand attributes.

> *A **boreal mixedwood site** is an area with climatic, topographic and edaphic conditions that favour the production of closed canopies dominated by trembling aspen or white birch in early successional stages, black spruce or white spruce in mid-successional stages and balsam fir in late successional stages.*
>
> (MacDonald and Weingartner 1995)

Boreal mixedwood site conditions generally encompass (Pierpoint 1981, MacDonald and Weingartner 1995):

- deep, well-drained, fertile soils on mid-slope positions
- rapid incorporation of organic matter into the mineral soil
- abundant ground vegetation and species richness

Ontario's boreal mixedwood site conditions do not include wet lowlands, xeric and dry glacio-fluvial deposits, or shallow soils with strong bedrock control.

A site-based approach to define boreal mixedwood conditions was used because:

- soil conditions provide a stable framework for ecological reference
- site condition influences the biological legacy, reproductive success, and productivity of a tree species
- a relationship between site, disturbance frequency and intensity, and pre-disturbance conditions influences the development of boreal mixedwood stands
- sites that currently do not support boreal mixedwood stands may, if appropriate silviculture is applied

> *A **boreal mixedwood stand** is a tree community on a boreal mixedwood site in which no single species exceeds 80 percent of the basal area.*
>
> (MacDonald and Weingartner 1995)

When the definitions of boreal mixedwood sites and stands are compared:

- a boreal mixedwood ***stand*** must contain at least two species and be on a boreal mixedwood site; the species may differ in age or size
- a boreal mixedwood ***site*** may support one or more of the defining or associated tree species (see Table 1) at a given point in succession
- several boreal mixedwood stands may occur on a single, uniform boreal mixedwood site

Extent of This Guide

Forest conditions across northern Ontario are extremely variable, and an almost endless number of species and site combinations can be identified and managed as boreal mixedwoods. This silviculture guide provides a framework for boreal mixedwood management, and focuses on the ecological conditions that support developing and maintaining spruce-fir-birch-aspen mixtures in northern Ontario. While jack pine can be a major component of some boreal mixedwood stands in Ontario, there was insufficient documented silviculture information to provide direction on managing jack pine mixedwoods. Some information is provided in OMNR (1997c) to aid in managing jack pine and intolerant species mixtures. As our understanding of the ecology and management of all boreal mixedwood conditions (including jack pine mixedwoods) increases, a broader definition of boreal mixedwood stands will be incorporated into future versions of this guide.

For this version of the boreal mixedwood guide:

- at least one of the defining boreal mixedwood tree species (see Table 1) must be a canopy component
- there is no requirement for a hardwood/conifer mixture; for example, early successional stands can be composed of two or more intolerant pioneer hardwood species; likewise, late successional stands may be composed of shade tolerant conifer-conifer mixtures.

Why Manage for Boreal Mixedwoods?

There are many reasons to manage for boreal mixedwoods, including the extent of the resource, ecological factors, achievement of multiple values, and economic considerations.

The Extent of the Resource

The range of boreal mixedwood sites and stands presently covers approximately 50 percent of the productive forests in northern Ontario (McClain 1981, Armson 1988, Towill 1996, Towill *et al.* 2003). As well, the area of Ontario's productive forest comprised of boreal mixedwood stands is increasing. A combination of past harvesting practices, increased use of natural regeneration for renewal, and greater fire suppression activities have combined to increase the total area of hardwood and mixedwood stands in second growth boreal forests (Hearnden *et al.* 1992, MacDonald 1995).

Ecological Factors

Boreal mixedwood site and stand conditions provide an ecological basis for sustainable forest management for the following reasons (MacDonald 1995):

- the resilience of ecological processes is enhanced by managing individual stands with succession and by managing for multiple species on a site
- genetic and species diversity enables an ecosystem to adapt to long-term environmental changes and recover from short-term major disturbances
- pest resistance is high because of the diversity of species on a site
- enhancement of soil nutrient status occurs; hardwoods tend to increase nutrient cycling on a site
- managing for a variety of successional stages emulates the natural successional patterns of a site

Multiple Values

The objective of maintaining mixed-species stands on the landscape is to create an environment where many values can be achieved. These include:

- high quality fibre production

Table 1. Defining and associated boreal mixedwood species.

Defining Boreal Mixedwood Species	Associated Boreal Mixedwood Species	
Trembling aspen	Jack pine	Large tooth aspen
White birch	White pine	Balsam poplar
Black spruce	Red pine	White elm
White spruce	White cedar	Black ash
Balsam fir	Tamarack	

(adapted from MacDonald and Weingartner 1995)

- improved aesthetics due to the variability of the landscapes
- more recreational opportunities
- diverse wildlife habitat

Economic Considerations

Boreal mixedwood site and stand conditions may provide (MacDonald 1995):

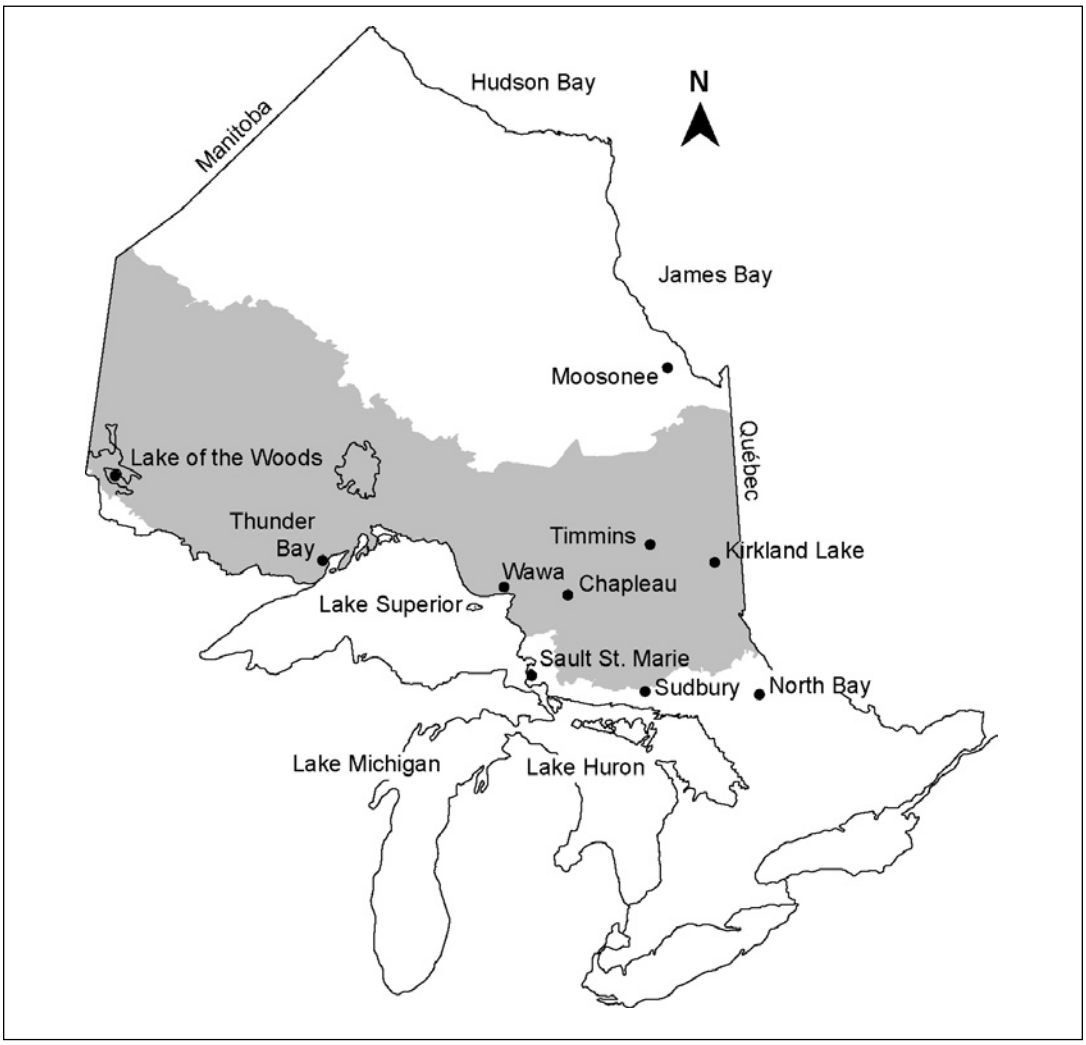
- sources of high quality wood
- product diversity – a broad range of species is available
- year-round harvesting opportunities
- inexpensive regeneration by managing with succession
- high total yields per hectare

Geographic Distribution of Boreal Mixedwoods in Ontario

In Ontario, boreal mixedwood sites and stands occur throughout the boreal forest and the Boreal-Great Lakes-St. Lawrence transitional forest (Figure 1). They extend between the 48˚ N and 53˚ N latitudes, and from Manitoba in the west to Québec in the east. The northern boundary coincides with climatic indicators of potential evapo-transpiration and the 13˚ C mean July temperature isotherm (Royal Commission of the Northern Environment 1985). The southern boundary is more difficult to discern because of the mixture of species and the lack of distinct, persistent species associations in the Boreal-Great Lakes-St. Lawrence transitional forest (Hare 1950, Maycock and Curtis 1960, Sims and Uhlig 1996). However, it corresponds roughly to the 5˚ C mean annual isotherm east of Lake Superior and the 4˚ C annual isotherm to the west (Thompson 2000). Mean annual temperatures are 0˚ to 3˚ C and the mean annual precipitation is 700 to 950 millimetres (Rowe 1972, Sims and Uhlig 1996, Chen and Popadiouk 2002). There may be isolated stands located beyond the southern boundary where conditions meet the definition of a boreal mixedwood. Forest managers encountering these locations may choose to refer to this guide for management direction.

The Ontario Shield Ecozone contains nine ecoregions, six of which are included in the geographic area covered by this guide (3S, 3W, 3E, 4S, 4W, and 4E). These ecoregions are differentiated based on broad regional climatic regimes that influence vegetation distribution and productivity (Crins *et al.*, in prep.). Moving from north to south across the province and between ecoregions, there is an increase in temperature. Moving from west to east, there is a general increase in humidity. Major continental air masses and the relative positions of the major water bodies within the province contribute to these trends. Differences in temperature, precipitation, and associated disturbance patterns (type, frequency, and intensity) between the six ecoregions are outlined in Appendix 1. Because of these differences, silvicultural practices may in some cases, vary among ecoregions.

Figure 1. Ontario's boreal forest and the Boreal-Great Lakes-St. Lawrence transitional forest.



An Ecological Approach to Forest Management

Managing For Biodiversity

In the strategic direction statements *Direction '90s* (OMNR 1991a), *Direction '90s… Moving Ahead 1995* (OMNR 1995), and *Beyond 2000* (OMNR 2000), the OMNR embraced sustainable development as a business principle. This direction calls for an ecosystem-based (ecological) approach to the management of Ontario's natural resources. Adopting an ecological approach to management involved a change in emphasis, from resource extraction to one that maintains healthy ecosystems for future use.

This relatively new focus of maintaining sustainable healthy ecosystems over time requires an understanding of the variability amongst living organisms and the ecological complexes in which they can occur (biodiversity). One way of viewing biodiversity is by looking at ecosystem composition, structure, and function over different spatial scales (Noss 1990). This framework can be used to identify the components of biodiversity in forest management (Table 2).

Forest management planning influences stand composition and structure largely through the silvicultural treatments prescribed in silvicultural

Table 2. A framework for identifying the critical components of biological diversity in forest management (adapted from Noss 1990).

	Composition	Structure	Function
Landscape (forest)	Area Selected for Harvest		
	area of each forest type	size, shape and spacing of patches	fire and insect spread
	age class distribution	corridors	habitat and wood supply
Site (stand)	Silvicultural Ground Rules		
	species composition – all layers	snags, coarse woody debris, super-canopy trees, multi-storied canopies	habitat suitability, nutrient cycling
Population	relative abundance/biomass of species	age/sex ratios	fertility, recruitment, mortality rates
Gene	number of different alleles, presence of rare alleles	effective population size, heritability, overlap	inbreeding depression, genetic drift, mutation rates

ground rules and forest operations prescriptions. Silvicultural ground rules and treatment packages are developed to meet management objectives and are based on a knowledge and understanding of stand and site attributes.

Silvicultural ground rules seek to achieve specific types of desired future stand conditions, while sustaining ecosystem health. The most effective silvicultural treatments are often innovative applications of intervention that come from an intimate understanding of the prevailing natural processes on a site.

Forest ecosystems, or ecosites, are the basis for both ground rules and prescriptions.

Managing With Succession

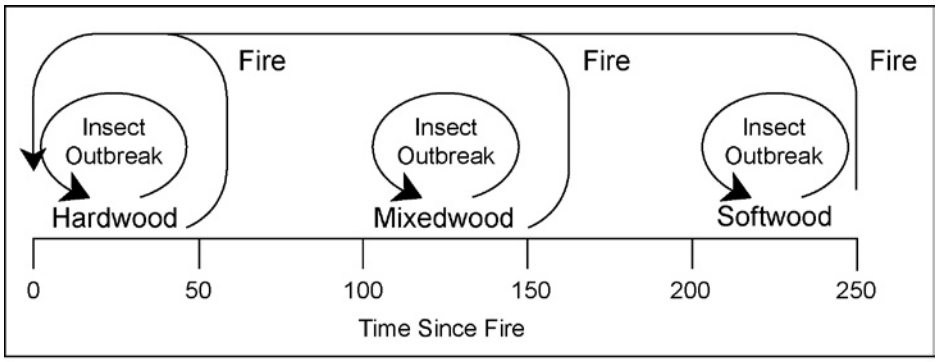
The primary principle underlying Ontario's approach to mixedwood management is to design and implement silvicultural treatment packages that direct future stand development according to natural successional patterns (MacDonald 1995) to meet strategic objectives established in a forest management plan. By "managing with succession", opportunities exist to use regeneration strategies that capitalize on the biological legacy of a boreal mixedwood site or stand, influencing the development of a desired future stand condition while maintaining the ecological processes of a site.

Bergeron and Harvey (1997) have proposed a similar approach for mixedwood conditions in Québec's southern boreal forests (Figure 2). Following a stand-replacing disturbance like fire, a stand goes through an early stage dominated by intolerant hardwoods that colonize the site. If left undisturbed, the stand will naturally develop over time into a mixed stand of intolerant hardwood and tolerant softwood (conifer) species. If the stand continues to remain undisturbed it will then develop into a future softwood dominated mixedwood (see Section II).

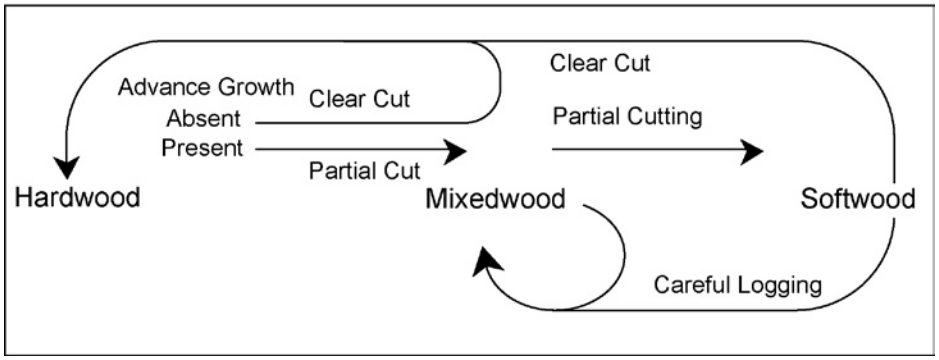
At each successional stage the stand may experience disturbances (insects, disease, wind, fire, etc.). Depending on the severity of the disturbance, the stand's successional position may be altered. For example, the stand may remain in its current position or return to a previous successional stage. Bergeron and Harvey (1997) suggest that natural successional patterns can be emulated through silvicultural practices. This approach to management forms the basis of this guide.

Figure 2. Successional patterns in Québec's boreal forest (a) and silvicultural emulation of these patterns (b) (Bergeron and Harvey 1998).

a



b



Achieving a future softwood dominated stand condition as a result of directing a stand through the various successional stages by means of successive silvicultural interventions requires detailed planning and long-term documentation. *Forest Management Planning Manual for Ontario's Crown Forests* (OMNR 1996) requires that silvicultural strategies for each of the forest units being described are recorded in the forest management plan.

It is important to understand that the silvicultural ground rules and treatment packages described in FMP-10 (OMNR 1996) detail only those prescribed silvicultural activities that move a stand or group of stands with similar attributes from a current stand condition to a desired future stand condition in one sequenced intervention. Thus, it is necessary to ensure that silvicultural ground rules are available for all combinations of current stand composition types/successional stages (stand development stages) where canopy manipulation may be undertaken. The silvicultural strategy for emulating natural successional patterns in boreal mixedwoods, therefore, consists of one or more sequenced interventions. These "related" silvicultural ground rules are linked by virtue of sharing a common broad soil group (see Section II). They also share a common end (future stand condition) and beginning point (current stand condition) such that they can be "linked together" along a temporal scale.

Organizing our Silvicultural Knowledge: Use of General Standard Site Types

Forests are complex systems with many interactions among species and environmental conditions. A forest ecosystem classification simplifies this complexity, so that patterns and common features can be recognized and applied at a practical management level. Information from a forest

ecosystem classification, such as a description of ecological units such as ecosites, is one tool that can help resource managers develop silvicultural prescriptions. However, no classification system can encompass all of the complexity and diversity in a landscape.

The *Forest Management Planning Manual for Ontario's Crown Forests* (OMNR 1996) requires that ecosites be used as building blocks to describe forest units when modelling forest sustainability, developing silvicultural ground rules, and reporting forest operations prescriptions within annual work schedules. Ecosites are an appropriate tool for describing a productive forest land base and for use in other forest management planning applications at this scale.

Ecosites are defined in terms of abiotic (soil depth, texture, moisture regime, hydrology, and nutrient regime) and biotic (plant community structure and composition) factors. In fact, ecosites may represent different stages of stand development. Some silvicultural considerations may be broadly interpreted from a description of an ecosite, including: tree growth and yield; vigour of competing species; potential advance growth and ingress of naturals; and site hazard potential, such as rutting and compaction.

Some of these factors, such as forest productivity and vigour of competing species, will vary for a given soil condition when there are variations in climate. Therefore, interpretations for an ecosite must be considered in a broader ecological context (e.g. ecoregions and ecodistricts).

An ecosite-based forest inventory can help resource managers model forest development, assess sustainability, and identify candidate boreal mixedwood sites. However, given the complex nature of boreal mixedwood sites, more stand level information on stand composition and structure will be needed to fully implement boreal mixedwood prescriptions. This information is best obtained from a field-based inspection of the candidate site (referred to here as a pre-harvest assessment) to assess the variability of individual stand components and to verify soil and site conditions.

Confirmation of this additional information, as part of the forest operation prescription verification process, should be completed before a boreal mixedwood silvicultural prescription is implemented. Some of the key factors to be noted in such a pre-harvest field assessment include:

- soil conditions (confirming a boreal mixedwood site)
- tree species and vigour of all vegetative strata (including advance growth)
- stand structure and development stage
- seedbed conditions

Identifying these features and their distribution within a stand, is the key to successfully implementing boreal mixedwood prescriptions. More details on this topic are provided in Section V, and an example of a form that may be helpful in gathering this additional information is in Appendix 5.

Setting the Management Context

Sections IV, V, and VI provide guidance for the application of site- and species-based interpretative ecological and management information during the forest management planning process. However, this boreal mixedwood guide is only one of many sources of information to be consulted when preparing silvicultural ground rules. Silvicultural knowledge and experience gained by members of a local forest management planning team is also a critical component.

Building Forest Units

For management purposes, a forest unit is an aggregation of forest stands that have similar species composition, develop in a similar manner (both naturally and in response to silvicultural treatments), and are managed under the same silvicultural system (OMNR 1996). While ecological factors provide the basis for defining forest units, other considerations such as economics and product requirements may also be addressed. Typically, forest units are specific to the needs of each forest management unit.

From an ecological perspective, derivation of forest units is generally best achieved using ecosites as building blocks; forest units will eventually be linked with specific ecosites to describe current stand conditions. In the absence of mapped forest ecosites, forest resource inventory information (species composition, age, site class, and stocking) can be integrated with local knowledge and existing sources of ecological information to build forest units.

The descriptions of forest units may be somewhat broad when they are based on ecosites. However, by definition, the description of a forest unit must be specific enough to imply a predictable pattern of development. For boreal mixedwood management, forest units can be refined using species composition and stand development stages. Section II establishes boreal mixedwood stand composition types and stand development stages and identifies four broad soil-based ecosite groupings that should be considered when deriving boreal mixedwood forest units.

Forest units developed for boreal mixedwood conditions should consider previously established "Regional Standard Forest Units" in order to facilitate modelling and comparison of modelling results between adjacent forests, ecodistricts, and ecoregions.

Developing Silvicultural Ground Rules

Silvicultural ground rules are specifications, standards, and other instructions that direct forest management practices on a forest management unit during the period of a forest management plan (OMNR 1996). Each ground rule is a unique combination of three components: current stand condition, future stand condition, and a silvicultural treatment package. Silvicultural ground rules must be developed based on the requirements of the current forest management planning manual.

Silvicultural ground rules are developed within the context of forest level management objectives, while providing stand level direction. These ground rules serve as inputs to the analysis tools used to project forest development; care must be taken to select appropriate silvicultural activities to achieve the desired future stand condition. One of the most important aspects in creating silvicultural ground rules is the construction of ecologically-based forest units.

Preparing Silvicultural Treatment Packages

Silvicultural treatment packages refer to a range of acceptable treatments (harvest, renewal, and tending) on the appropriate forest unit that can be undertaken at various intervals throughout the life of a stand to achieve a desired future stand condition (OMNR 1996). For each current forest unit/site type combination, one or more harvest-to-harvest strings of activities may be described to achieve the predicted future stand condition. Each silvicultural treatment package includes: a silvicultural system, harvest method, logging method, renewal treatments (site preparation and regeneration), tending treatments, and regeneration standards.

Developing Silvicultural Ground Rules with This Guide

Silvicultural ground rules are included in every forest management plan. A number of components must be specified to complete the description of a silvicultural ground rule. The categories below refer to portions of a silvicultural ground rules table and explain where information in this guide may be applicable.

Current Forest Stand Conditions

Forest Unit

Forest resource inventory parameters and other criteria may be used to assign a stand to a forest unit (for developing forest units, see Building Forest Units, described previously and Appendix 2). Sections II and IV of this guide provide the ecological framework for understanding ecosite groupings useful in defining boreal mixedwood forest units.

Site Type

The ecosites, or portions of ecosites, that are used to define a forest unit will be identified in the ground rule. The identification of ecosites will provide information about abiotic (e.g. soil depth, texture, and moisture regime), and biotic (overstorey and understorey condition) factors that will determine the silvicultural treatment package selected.

For boreal mixedwood management, specific stand characteristics may be identified as additional prerequisites for implementing a particular silvicultural treatment package. This information can include: species composition and distribution, stand structure, stage of development, understorey condition, and status of advance growth.

Section VI should be consulted to identify the critical stand characteristics necessary for developing management strategies for boreal mixedwoods. These key features must be identified in the "site type" description of the silvicultural ground rule. They must also be confirmed during the verification of the forest operation prescription before the silvicultural ground rule may be implemented.

Future Forest Stand Conditions

Silviculture is used to direct a stand from its current condition to a desired future stand condition. To ensure a stand develops as desired, action may need to be taken before, during, and after harvest. Boreal mixedwood management often involves repeated silvicultural interventions, the results of which must be carefully monitored.

The ability to predict future stand conditions begins with an understanding of species autecology and their associations on a site and how various silvicultural treatments affect future stand development. Section II summarizes the ecological framework upon which the management of boreal mixedwoods in this guide is based. Section VII provides specific autecological information for boreal mixedwood plant and tree species that are commonly associated.

Forest Unit

Depending on the management objectives and silvicultural treatment packages, a current forest unit may be directed to a variety of future forest units. Individual silvicultural ground rules must describe only one future forest unit. Sections II and IV of this guide provide the ecological framework for understanding ecosite groupings useful in defining potential future forest units.

Development Information

Development information reflects predicted future stand development from the application of each silvicultural ground rule. Typically, these are yield curves for selected tree species but, depending on the management objectives, could be yield curves for other stand attributes like snag density or browse production.

The yield curves assigned to each future forest unit are used to assess forest sustainability. For boreal mixedwood management, development information should be identified by broad soil group (see Section II), species composition types (see Section II), and silviculture intensity class (e.g. present, extensive, basic, and intensive).

Stand Characteristics

Future species composition and stand structure following application of a silvicultural ground rule must also be described. Stand structure may describe a stand as a mixedwood mosaic (species in discrete patches or intermixed) or as a stratified mixedwood (species separated in understorey and overstorey). These stand characteristics must be described for a specific future stand development stage (e.g. canopy transition). Species composition at other stand development stages or ages, and additional information such as stand density or product, may also be included.

Silvicultural Treatment Package Components

Section III outlines silvicultural practices appropriate for boreal mixedwood management in Ontario. The tables and fact sheets in Section VI provide information for understanding and applying management interpretations in specific boreal mixedwood conditions.

Silvicultural System

Boreal mixedwood management may involve one of three silvicultural systems: clearcut, shelterwood, or selection. The choice of silvicultural system is related to the management objectives, the current forest composition and stage of stand development, and the capacity of the tree species to regenerate and grow under certain ecological conditions.

The management interpretations outlined in Section VI identify those silvicultural systems specific to current stand condition and targeted future stand condition.

Harvest Method

Harvest method is a term used to further define or modify one of the three basic silvicultural systems, specifically the harvesting component or technique (e.g. strip clearcut). It defines the timing and pattern of removal and distribution of residual stems.

Sections III and VI discuss recommendations for harvest methods.

Logging Method

There are three logging methods to choose from: full-tree, tree-length, and cut-to-length (shortwood). The choice of logging method will have an impact on the selection of renewal treatments.

Ecosite descriptions offer information on stand composition, depth of organic matter, soil moisture, and soil texture that, when combined with logging method, will affect associated renewal treatments such as site preparation, regeneration, and tending.

Site characteristics, limitations, and hazard potential are considerations that may direct the selection of an alternate logging method (e.g. sites associated with steep slopes or rutting potential). When there are logging method options, the circumstances under which the different methods will be used should be indicated (e.g. special conditions determining the type of logging equipment or season of harvest).

Sections III and VI provide guidance on recommended logging methods for mixedwood conditions.

Regeneration

Ecosite information will include information on soil and vegetation characteristics that could affect the selection of a regeneration method. A pre-harvest assessment should be conducted to confirm the pre-harvest stand structure and composition that will be considered in the selection of a regeneration strategy. Species, quantity and quality of advance growth, and the probability of natural ingress will also be assessed, resulting in a decision about whether these components form part of a regeneration strategy. Site productivity information can be used to help select target species for renewal.

Information in Sections III and VI can be used to develop options for regeneration.

Site Preparation

Site preparation treatments may be prescribed for a portion of a stand (directed) or throughout the stand (broadcast). The choice of a site preparation technique may vary if advance growth is to be relied on to form part of the new stand. The probability and density of natural ingress are related to seedbed condition and may also affect the choice of site preparation technique.

The interaction between site preparation and reproductive strategies for potential competing species should also be assessed. The potential for site damage under certain ecological conditions must also be considered.

Sections III and VI include information regarding site preparation treatments.

Tending Treatments

Tending treatments include cleaning and intermediate stand treatments. Cleaning treatments may be applied throughout the stand (broadcast) or only on certain species or portions of the stand (directed). The method of tending (e.g. manual, chemical, chemi-mechanical, etc.) may also be indicated.

Other tending and intermediate stand treatments include juvenile spacing, pre-commercial thinning, compositional treatments, liberation treatments, and commercial thinning.

Information regarding tending treatments and methods is found in Sections III and VI.

Regeneration Standards

Regeneration standards are the benchmarks for determining if a silvicultural treatment package is moving a stand from the current stand condition to the desired future stand condition. These standards must relate to the future stand characteristics and associated yield curves. The requirements for regeneration standards are specified in the *Silviculture Effectiveness Monitoring Manual for Ontario* (2001c).

Sections V and VI provide further guidance and discussion concerning the establishment of regeneration standards for boreal mixedwood stand conditions.

Preferred and Exception Activities

Refer to the *Forest Management Planning Manual for Ontario's Crown Forest* (OMNR 1996) for direction about "preferred silvicultural treatment packages".

Silvicultural treatment packages that contain activities that are not in accord with the provincial silviculture guides (i.e. are not included in this or other silviculture guides or are "not recommended" or "developmental" activities), may still be permissible but must be noted as an "exception." Further direction on exceptions is found in the *Forest Management Planning Manual for Ontario's Crown Forest* (OMNR 1996).

Legislative and Policy Framework for Sustainable Forests

The context for forest management in Ontario is the *Policy Framework for Sustainable Forests* (OMNR 1994). The policy framework states that the goal for Ontario's forests is:

> *"…to ensure the long-term health of our forest ecosystems for the benefit of the local and global environments while enabling present and future generations to meet their material and social needs."*

This framework sets the broad direction for forest policy and establishes forest sustainability as the primary objective for long-term forest health and the sustainable development of forest resources.

The legislative authority for OMNR to establish forest sustainability as the primary objective of forest management is found in the CFSA (CFSA 1994). The CFSA is enabling legislation that provides for the regulation of: forest planning, information, licensing, trust funds, processing facilities, remedies, enforcement, and transitional provisions. The Act allows for the management of all forest-based values.

The CFSA requires the creation of four regulated manuals that provide details of forest planning, forest information, the scaling of timber, and the standards to be followed when conducting forest operations (OMNR 1995c). Ontario provides the standards and guidelines for forest operations conducted on Crown land in a series of guides, such as this silviculture guide. Each of these guides is listed in the *Forest Operations and Silviculture Manual* (OMNR 1995b). It is through this regulated document that forest managers are required to follow the direction included in this silviculture guide.

The CFSA defines sustainability as long-term Crown forest health. It defines forest health as the condition of a forest ecosystem that sustains an ecosystem's complexity while providing for the needs of the people of Ontario.

One of the guiding principles of the Act states:

> *"The long term health and vigour of the Crown forest should be provided for by using forest practices that, within the limits of silvicultural requirements, emulate natural disturbances and landscape patterns while minimizing adverse effects on plant life, animal life, water, soil, air and social and economic values, including recreational values and heritage values."* (Section 1(3):2)

Applying silvicultural systems, harvesting methods, and regeneration treatments that emulate natural disturbances at the landscape, stand, and individual tree level is an important part of Ontario's approach to forest management. The *Forest Management Guide for Natural Disturbance Pattern Emulation* (NDPE) (OMNR 2001b) provides direction for resource managers about creating landscape patterns, structural legacy, and residual stand structures that resemble post wildfire conditions. Boreal mixedwood stands have a high retention of structural attributes following wildfire (insular and peninsular residual patches; individual residual trees; large, dead, and downed woody debris) and offer significant opportunities for retaining or creating these structural attributes in conjunction with harvesting.

The *Forest Management Guide for Natural Disturbance Pattern Emulation* (OMNR 2001b) also considers the importance of forest conditions with an uneven-aged stand structure. Silvicultural systems, harvest methods, and renewal treatments can be employed to create future stand conditions with compositional and structural elements associated with late successional conditions or those derived from non-stand-replacing disturbances (i.e. low intensity surface fires, insect- and disease-related mortality). The natural disturbance pattern guide also identifies the importance of employing natural and/or assisted natural regeneration where it is appropriate to sites and species, and where it has proven reliable as a means to produce the desired future stand condition.

The development of objectives and measurable targets associated with a planned future stand condition is an important aspect of evaluating forest sustainability. Strategies can then be developed and implemented that will assist in achieving desirable future stand conditions and related objectives. This guide provides information on various silvicultural systems, harvesting methods, and renewal treatments that can be used to manipulate stand structure, composition, and site utilization to favour a desired future boreal mixedwood stand condition identified during the planning process.

Monitoring and evaluating future stand conditions compared to planned outcomes provides a means for continual refinement, redevelopment, and improvement of OMNR's silvicultural strategies and practices. The achievement of desired future stand conditions is based on our understanding of forest ecosystems and the application of management practices consistent with our understanding. This mixedwood guide provides some of the silvicultural concepts and tools to make this possible. For related information and operational direction see the *Forest Management Planning Manual for Ontario's Crown Forests* (OMNR 1996), *Forest Operations and Silviculture Manual* (OMNR 1995), and the *Silvicultural Effectiveness Monitoring Manual for Ontario* (OMNR 2001c).