Ontario

Silvicultural Guide to Managing for Black Spruce, Jack Pine, and Aspen on Boreal Forest Ecosites in Ontario

Book II: Ecological and Management Interpretations for Northwest Ecosites

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MNR’s Strategic Directions and its Statement of Environmental Values

The Ministry of Natural Resources (MNR) is responsible for managing Ontario’s natural resources in accordance with the statutes it administers. As the province’s lead conservation agency, the Ministry of Natural Resources is steward of provincial parks, natural heritage areas, forests, fisheries, wildlife, mineral aggregates, fuel minerals, and Crown lands and waters which make up 87 percent of Ontario.

In 1991, the Ministry of Natural Resources released a document MNR: Direction ’90s which outlines the goal and objectives for the Ministry, which are based on the concept of sustainable development, as expressed by the World Commission on Environment and Development. Within MNR, policy and program development take their lead from Direction ’90s. Those strategic directions are also considered in Ministry land use and resource management planning.

More recently, in 1994, the Ministry of Natural Resources finalized its Statement of Environmental Values (SEV) under the Environmental Bill of Rights. The Statement of Environmental Values is a document which describes how the purposes of the Environmental Bill of Rights (EBR) are to be considered whenever decisions that might significantly affect the environment are made in the Ministry.

The Ministry’s SEV is based on MNR: Direction ’90s. The Ministry has taken this approach to its SEV because the strategic direction outlined in MNR: Direction ’90s reflect the purposes of the EBR.

During the development of this silvicultural guide, the Ministry has considered both MNR: Direction ’90s and its Statement of Environmental Values. This guide is intended to reflect the directions set out in those documents and to further the objectives of managing our resources on a sustainable basis.

FOREWORD

Silvicultural Guides

This is the Silvicultural Guide for Boreal Forest Ecosites in Ontario. This guide replaces *A Silvicultural Guide to the Spruce Working Group in Ontario* (Arnup *et al.* 1988), *Jack Pine Working Group* (OMNR 1986), and *A Silvicultural Guide to the Poplar Working Group in Ontario* (Davison *et al.* 1988).

The project to review, revise and rewrite the silvicultural guides grew out of a legal requirement stated in Term and Condition 94 (T&C 94) of the class environmental assessment for timber management on Crown lands in Ontario (MOEE 1994). T&C 94 states that “all existing silvicultural guides shall be reviewed to ensure that they reflect current scientific knowledge as it applies to Ontario, and to provide descriptions of general standard site types for use in developing silvicultural ground rules in timber management plans.”

General standard site types, as defined in the *Forest Management Planning Manual for Ontario’s Crown Forests* (OMNR 1996), are synonymous with ecosites and site types, the working units of forest ecosystem classification (FEC) systems.

The *Silvicultural Guide to Managing for Black Spruce, Jack Pine, and Aspen on Boreal Forest Ecosites in Ontario* provides silvicultural information within the context of forest ecosystems. This represents a significant change from the working group (crop species) approach used in the earlier silvicultural guides.

Guideline Revision

Ecosystems and our understanding of them are never static. As science, knowledge and experience add to our understanding of boreal forest ecosystems, this guide will continue to evolve. It is a work in progress that we will revise, improve and update so that it continues to reflect current knowledge and experience, while providing us with the tools to adapt to the challenges that lie ahead.

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This guide is presented
in memory of Neil Maurer,
a dedicated forester
who was very much at
home in Boreal Ontario,
and who believed very
strongly in the application
of science to make forest
practices better.

ABOUT THIS GUIDE

This guide provides silvicultural and ecological information for the management of black spruce (*Picea mariana* (Mill.) B.S.P.), jack pine (*Pinus banksiana* Lamb.) and aspen (*Populus tremuloides* Michx., *Populus grandidentata* Michx.), within the context of sustainable forest management.

Our intention in developing this silvicultural guide is to provide:

- a reference tool for developing forest units and silvicultural ground rules
- an overview of current boreal silvicultural science and knowledge in Ontario
- a repository for silvicultural experience in Ontario's boreal forest
- a training and educational tool.

This guide is one of several publications associated with the Forest Management Planning Manual (OMNR 1996), which is a regulating document under the Crown Forest Sustainability Act (CFSA 1994). This guide specifically identifies silvicultural practices (required in silvicultural ground rules) within the ecological framework provided by general standard site types.

This guide is not intended to be the sole source of silvicultural information, or a substitute for local knowledge and experience. It is also not intended to constrain the application of sound silvicultural practices. It provides a framework and a context for generating, collecting, validating and applying local knowledge and experience in the Boreal Forest of Ontario. For more information on the science of silviculture in Ontario, see *Regenerating Ontario's Forests* (Columbo and Wagner in prep.).

How this Guide is Organized

This guide includes three books. Book I: Silviculture in Ontario, includes:

Section I.	**Introduction**, presents the legislative, philosophical, and ecological context in which the guide was developed.
Section II.	**Silvicultural Practices**, provides an overview of the science, art and practice of silviculture in Ontario's boreal forest. This also section attempts to rationalize and present a standard set of silvicultural terms for use in the forest management planning process.
Section III.	**Autecology of Selected Forest Plants**, provides information about the response and adaptation of selected crop trees and competitor species to the physical environment, disturbance, and management intervention.
Section IV.	**Silvicultural Decision Tools**, presents a catalogue and short description of decision-support tools available for boreal Ontario.
Section V.	**Applying this Guide**, demonstrates how to use the guide to build forest units, silvicultural ground rules and silvicultural treatment packages.

Book II: Ecological and Management Interpretations for Northwest Ecosite (this book), includes:

Section I.	**The Ecological Framework** introduces and explains the ecological and management interpretations in Section II, the terms and graphical conventions used, how the interpretations were derived, the limitations to their application, and data sources.
Section II.	**Ecological and Management Interpretations** delivers a suite of ecological and silvicultural information, within the framework of general standard site types, as defined by the Terrestrial and Wetland Ecosites of Northwestern Ontario (Racey *et al.* 1996).

Book III: Ecological and Management Interpretations for Northeast Site Types, includes:

Section I.	**The Ecological Framework** introduces and explains the ecological and management interpretations in Section II, the terms and graphical conventions used, how the interpretations were derived, the limitations to their application, and data sources. This section also includes a comparative cross-reference of selected Central Ecosites and Northeast FEC Site Types.
Section II.	**Ecological and Management Interpretations** delivers a suite of ecological and silvicultural information, within the framework of general standard site types, as defined by the Forest Ecosystem Classification for Northeastern Ontario (McCarthy *et al.* 1994).

Section I

The Ecological Framework

Site specific management requires integrating silvicultural practices with ecological conditions to meet desired objectives. Objectives may be ecological, social or economic, and are often combinations of all three. The interpretations in Book II are described in this section and build a knowledge bridge between ecology and management. Management interpretations presented in Book II were developed with a view of achieving at least 80 percent stocking of black spruce, jack pine or aspen (i.e. favoring the regeneration of that species). However, these interpretations are not restricted to obtaining an 80 percent stocking of a single species, but can be combined towards achieving any desired future forest condition.

There are two general types of interpretations presented. Ecological and management. Ecological interpretations describe the interactions between plants, animals and abiotic factors associated with the site and related to forest productivity, successional relationships or understorey species composition. Management interpretations combine knowledge about silvicultural practices and their suitability to meet renewal objectives for a given site.

Natural ecosystems are inherently variable. All individual land units are essentially unique. As a result, any attempt to classify a set of ecological conditions into ecosites will result in a description of a *modal* condition — a generalized depiction of average conditions. Ecological descriptions of the modal condition may approximate many specific locations while at the same time describe none perfectly. Therefore, verification of site and stand conditions in the field is essential for formulating site specific prescriptions.

The Ecological Interpretations section provides a framework for including additional local ecological data for a management unit. Adaptive management, which uses new data to improve the ecological description of the modal condition, will improve the precision and accuracy of these ecosystem descriptions. Examples of such data include natural ingress rates, advance growth and successional changes.

NORTHWEST REGION ECOSITES

Terrestrial and Wetland Ecosites of Northwestern Ontario (Racey *et al.* 1996) describes 28 forested ecosites (ES11 to ES38). These ecosites represent mapping units and integrate a consistent set of environmental factors and vegetation conditions. They are defined in terms of abiotic (soil depth, texture, moisture regime, hydrology and nutrient regime) and biotic (plant community structure and composition) factors.

The forested ecosites of northwestern Ontario are closely associated with landform complexes and broad overstorey composition. Soil texture and moisture regime are the primary soil attributes used to differentiate ecosites. Very shallow soil (<20 cm) ecosites are treated separately. Shallow, moderately deep and deep soil attributes are also recognized, but the classification recognizes soil depth as a modifier. Ecosite terminology is described in Racey *et al.* (1996) and in Book I of this guide.

NORTHWEST ECOSITE FACT SHEET

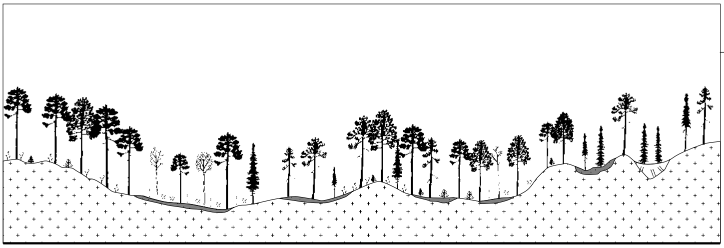
Each fact sheet presents a description of the average or modal vegetation, soil/substrate and site characteristics of an ecosite. They familiarize the user with information on vegetation composition, forest structure, relationship to V-types and W-types, humus, mode of substrate deposition, landscape position and relationship to other ecosites. The fact sheets do not represent a quantitative analysis, but rather relative abundance.

1. **Ecosite Name and Number** provide a handy index to ecosites. Ecosite numbers start at ES11 to accommodate ES1 to ES10, which have no fact sheets at this time. The name is derived from a vegetation component (i.e. dominant cover type) and a soil component (i.e. dominant soil texture, moisture or depth). (See page 23, Racey *et al*. 1996).
2. **Vegetation-substrate profile** is a schematic cross-section showing typical variation in vegetation structure, parent material, depth and texture, relief and topography. Plant silhouettes represent commonly occurring species. (See page 20, Racey *et al.* 1996).
3. **General Description** is a brief account of a site's vegetation, moisture regime, soil and site parameters. Herb- or shrub-rich/poor describes information on both species diversity and overall abundance within a stratum.
4. **Nutrient/Moisture Grid** shows the relative position of ecosites within a two-dimensional "ecological space" defined by axes representing approximate moisture and nutrient status. These axes are not calibrated to an absolute scale.
5. **Soil Types, Mode of Deposition and Humus Form** provide a general account of the most frequently encountered conditions typical of the ecosite. Soil type names follow Sims *et al.* (1997) (see page A-13). Mode of deposition or landform classes (e.g. lacustrine, morainal, glaciofluvial) are based on definitions in The Canadian System of Soil Classification (Canada Soil Survey Committee 1978).
6. **Overstorey, Shrubs/Trees, Herbs and Graminoids, Mosses and Lichens, Submergents and Floating-leaved Species.** The lists in ES11 to ES44 include those species represented in at least 40 percent of plots; those in ES46 to ES50 include species represented in at least 20 percent of plots. For all ecosites, these are the most common species in each stratum, presented in approximate order of decreasing frequency. Common names are used for tree species and scientific names for all others. Refer to *Appendix I* Scientific to Common Names or *Appendix II* Common to Scientific Names (Racey *et al*. 1996).
7. **Comments** provides supplementary information on vegetation, soil, variability and relationship to other ecosites. (See *Geographic Variation and Interpretation*, page 10, Racey *et al*. 1996). V-types, W-types and S-types listed on ecosite fact sheets refer to common ecoelements expected to occur within that ecosite. They do not imply that ecoelement defines the ecosite, or that other ecoelements could not occur. Characteristic V-types refer to conditions that could comprise the entire ecosite. Inclusions are V-types or S-types which superficially appear atypical, but occur often as a relatively small proportion of the ecosite.

1

Red Pine–White Pine–Jack Pine: Very Shallow Soil

ES11



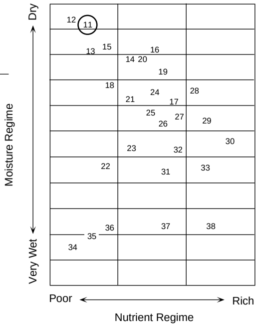
2

General Description

Conifer dominated stands with red, white and jack pine. Aspen, large-toothed aspen, white birch and white spruce occur occasionally. White cedar may be locally abundant. Shrub- and herb-poor. Soils very shallow (<20 cm) with bedrock outcrops. Ground cover consists of bedrock, needle litter, feathermoss and lichen.

3

4



Soil Types
SS1, SS2, SS3, SS4, SS5
Mode of Deposition
bedrock, morainal
Humus Form
fibrimor
Overstorey
jack pine, red pine, white pine
Shrubs/Trees (<10 m)
Diervilla lonicera, balsam fir, Linnaea borealis, Vaccinium myrtilloides, Vaccinium angustifolium, Arctostaphylos uva-ursi, Rosa acicularis, Juniperus communis
Herbs and Graminoids
Aralia nudicaulis, Maianthemum canadense, Oryzopsis asperifolia, Fragaria virginiana, Aster macrophyllus
Mosses and Lichens
Pleurozium schreberi, Cladina mitis, Cladina rangiferina, Cladina stellaris, Dicranum polysetum

5

6

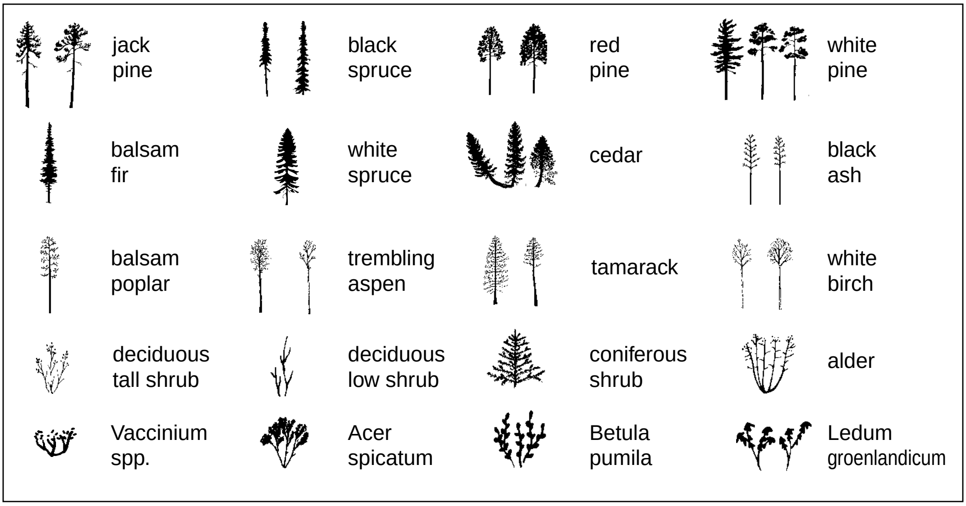
Comments

May occur as pure stands of red or white pine, or as a mixture of V12, V13, V26, V27, V29 and/or V30. However, due to extremely varied topography, a large number of other V-types and various mixtures of hardwood species may be found in small pockets of deeper soils. S-types SS1 to SS4 are characteristic and dominate (>50% of polygon area), but inclusions of SS5, SS6 and SS9 are frequent.

7

47

Short Forms, Symbols and Fill Patterns for Fact Sheets



Dry MR ø-1	Fresh MR 2-3	Moist to Wet MR ≥ 4	
░ coarse	▒ coarse	▓ coarse	▨ sedimentary peat
░ coarse / loamy	▒ coarse / loamy	▓ coarse / loamy	▨ fibric to humic peat
░ fine loamy clayey	▒ fine loamy clayey	▓ fine loamy clayey	▨ bedrock

Ab	black ash	*Fraxinus nigra*
Bf	balsam fir	*Abies balsamea*
Bw	white birch	*Betula papyrifera*
Ce	eastern white cedar	*Thuja occidentalis*
Ew	white elm	*Ulmus americana*
Pj	jack pine	*Pinus banksiana*
Pr	red pine	*Pinus resinosa*
Pw	white pine	*Pinus strobus*
Sb	black spruce	*Picea mariana*
Ta	tamarack	*Larix laricina*

Northwest ecosites are based on generalizations of species composition and soil variability based upon typical mappable ecosite polygons, and not from a specific plot by plot analysis. As such, fact sheets do not describe specific plot summaries of vegetation and soil data. Ecosite terminology and fact sheets are consistent with the NWO FEC. Detailed description of plot summaries of V-types and S-types are contained in Sims *et al.* (1997).

ECOLOGICAL INTERPRETATIONS

A discussion of the ecological and management interpretations developed for each ecosite, including the source of the information used to prepare the interpretation, is presented below.

There are many knowledge and information gaps and additional work is required to complete and improve the reliability of some of the interpretations.

Typical Landscape Associations

Landscape associations depict the typical sequence of ecosites that occur on a particular landform. The landscape toposequences depicted help to determine the relationship among neighboring ecosites and may be useful for building forest units for management planning. Landscape context is also an important consideration in understanding habitat value, operational constraints and interpreting aerial photographs. These associations were generated from an examination of aerial photographs, field experience and supporting research (Baldwin *et al.* 1990, Sims and Baldwin 1991).

Site Structure and Composition

Site characteristics for each ecosite consisting of overstorey composition, understorey composition, advance growth, seedbed and coarse woody debris are presented for three stand development stages (i.e. immature, mature, overmature). The stand development classes correspond to those listed in the *Forest Habitat Suitability Matrix for Northeastern Ontario* (D'Eon and Watt 1994). This preliminary information was developed from the 225 permanent sample plots from the Northwest Region Growth and Yield Program.

a) Overstorey/Understorey Composition

Figures are presented to outline the typical stand composition for the three development stages separated into overstorey and understorey composition. Tree species are identified by acronym and understorey vegetation is referred to by vegetation class. Percent values, expressed to the nearest 10 percent (e.g. 3 = 30 percent), refer to percent basal area for overstorey composition and percent cover for understorey composition. Mean and maximum values are presented; the dot indicates the mean value for that vegetation component and the bar indicates the maximum value.

b) Advance Growth

For each ecosite and age class combination having at least five samples, average density (stems/ha) are given for black spruce and balsam fir advance growth (less than 10 cm dbh). Percent stocking of advance growth is not available at this time.

c) Seedbed and Coarse Woody Debris (CWD)

For seedbeds, the mean percent cover of sphagnum moss (Sphag), feathermoss (Fthr), broadleaf litter (Bdlf), coniferous litter (Con) and lichen (Lichen) are listed for each ecosite. For coarse woody debris, the mean percent cover of logs (fallen dead wood greater than 7 cm in diameter), and debris (fallen dead woody material less than or equal to 7 cm in diameter) could not be derived from the permanent sample plot databases described previously.

Vegetation and Soil Type Relationships

The vegetation and soil type matrix describes the relationship between the ecosite and northwestern Ontario (NWO) FEC vegetation and soil types. Information to generate this interpretation came from the NWO ecological plot data base and expert opinion. As mappable units, ecosites are inherently variable. The matrix identifies the following three categories of vegetation and soil types:

- **Characteristic - common:** those vegetation and soil types that commonly occur across NWO, that are usually found as a significant component in the ecosite, and, that, alone, would be adequate to have the land unit characterized as that ecosite.
- **Common inclusions:** those vegetation and soil types that often tend to occur within the ecosite, sometimes significantly so, but alone are not adequate to have the land unit characterized as that ecosite.
- **Characteristic-uncommon or uncommon inclusions:** those vegetation and soil types which tend to be less common or very localized in NWO, that are usually found as minor components in the ecosite, but alone would be adequate to have the land unit characterized as that ecosite.

Selected Species Habitat Use

Habitat value for selected species is given for five forest stages: pre-sapling, sapling, immature, mature and overmature. The immature stage given in the site structure and composition figure is equivalent to the pre-sapling, sapling and immature stage. Habitat value is described as follows:

- **no symbol** - not used or selected
- **open circle** - used as encountered, when population is high, or when preferred habitat is in short supply
- **closed circle** - preferred, sought-out habitat or habitat used specifically for breeding, reproduction or survival during a critical period in their life cycle.

Additional notes on specific habitat preferences refer to habitat components not readily described by the ecosite, or requiring a landscape context (Sources: Northwest Habitat Matrix, unpublished. D'Eon and Watt 1994).

Successional Relationships - Natural

These figures show the changes under natural conditions in percent cover of stand components over time. The left graph depicts changes in percent cover of understorey components. The right graph depicts changes in percent cover of canopy species. This information is useful in understanding temporal changes in ecosite composition. Notes on typical successional trends in the absence of human disturbances may follow the figures. The figures are derived from NWO FEC data, NWO growth and yield permanent sample plot data and other sources of written documentation and expert opinion (Kenkel and Watson 1996, Service 1997).

Successional Relationships - Post-harvest

This section describes expected vegetation responses following harvest and mechanical site preparation, prescribed fire or herbicide treatment based on scientific literature and expert opinion. This information supports decisions affecting selection of renewal and vegetation management strategies. The main sources of information used to develop the successional relationships after disturbance include Bell (1991) and Chambers (1993).

Site Productivity

Site productivity, as expressed by site index, is presented for black spruce, jack pine and aspen on the common soil types associated with the ecosite. Site index is based on the average height of the dominant trees at 50 years breast height age. The limitations of this data are that ages from FEC are based on age at breast height (1.3 m), while the FRI ages are based on estimated date of stand origin. Consequently, FEC can give an overestimate of productivity relative to the FRI, especially on lowland (nutrient poor) sites. The site productivity estimates are a synthesis of the NWO prime land inventory data set, and height/age data collected from NWO growth and yield permanent sample plots. Data from a total of 5,547 individual trees from natural stands were used in this interpretation.

Black Spruce Advance Regeneration

This interpretation includes only black spruce advance regeneration < 2.5 cm dbh and/or < 2.0 m tall. These data provide an estimate of the mean percent stocking, stocking range and average density of black spruce regeneration for each of the characteristic V-types comprising the ecosite. Information sources include regional studies (Walsh and Wickware 1991, Buse and Farnsworth 1995).

Natural Ingress Probability and Density (ten years post-disturbance)

Expected levels of natural ingress (no advance growth is included) are estimated by species, seedbed and height class, ten years post-disturbance (Symons 1996, Bowling *et al*. 1997). Density class refers to the number of stems per hectare of ingress expected after ten years. Probability class refers to the proportion of samples in which the identified density class was observed.

The following seedbed conditions were identified:

- **undisturbed duff** - no site preparation for the purpose of mineral soil exposure has occurred
- **mineral soil** - mechanical site preparation for mineral soil exposure has occurred
- **burned**- natural (or prescribed) burning has occurred.

Additional comments beneath the table describe other ecological characteristics including the rate of ingress. Rate of ingress refers to the number of years for seedling establishment after the last disturbance. The last disturbance is harvest, site preparation, and burn for duff, mineral soil, and burned seedbeds, respectively.

Critical Comments

When included, these comments address ecological information that provide further insight into the physical and biological characteristics of the site.

MANAGEMENT INTERPRETATIONS

Management interpretations were developed for each ecosite. Many ecological factors interact with management practices to produce observed outcomes. Often those observed outcomes have been documented in scientific and technical literature and field inspection reports, or have been synthesized solely from the collective experience of resource managers. These interpretations represent a synthesis of both the literature and expert opinion. Because there is an inherent variability in the actual ecological condition represented by these ecosites, there will be considerable variation in treatment response to silvicultural practices.

The Management Interpretation tables provide quick reference information for determining the opportunities for managing either black spruce, jack pine or aspen on the ecosite. Resource managers must understand the ecology of the sites on which they are making management decisions. This understanding, combined with the management interpretations, may assist in designing cost-effective and biologically appropriate silvicultural treatment packages.

Site Characteristics, Limitations and Hazard Potential

This table flags potential concerns and considerations that should be recognized when management (i.e. silvicultural intervention) occurs on this ecosite. Three categories of silvicultural intervention are recognized: harvesting, renewal and tending. Hazards include those potential impacts on the physical environment which could negatively influence site productivity or contribute to environmental degradation. The site characteristics which are listed refer to those aspects of the physical and biological environment which contribute to hazard potential. Environmental variables such as intensity and duration of precipitation and temperature extremes must also be considered when interpreting and applying this table.

Information for these tables were largely derived from the *Forest Management Guidelines for the Protection of the Physical Environment* (Archibald *et al*. 1997).

Opportunities

When included, this section describes additional opportunities for managing the ecosite.

Silvicultural Intensity Considerations

This chart describes the productivity class and the relative degree of effort which will be required to achieve a free-growing stand for each of the tree species (black spruce, jack pine and aspen) on each ecosite. The degree-of-effort ranking was subjectively derived through expert opinion. Site productivity class (prime land productivity class) is based upon height of dominant trees for an individual species (age at 50 years breast height) (Towill 1997, in prep.).

The degree of effort categories are:

Extensive:	i.e. natural regeneration
Basic:	i.e. assisted natural: cone scattering, scarification and direct seeding
Intensive:	i.e. site preparation, planting, vegetation management, natural and pre-commercial thinning.
Highly intensive:	i.e. site preparation, planting, vegetation management, natural and pre-commercial thinning with multiple tendings and cleanings.

Silvicultural Interpretations

A species specific silvicultural interpretation table (for black spruce, jack pine and aspen) is presented for each ecosite. **These tables are designed to provide resource managers with site specific information to manage for a particular species on a site to reach desired future forest conditions. These tables also indicate when certain species are not appropriate for a site and should not be considered as a management objective.**

The interpretation tables have three columns. The left column identifies a specific treatment belonging to a silvicultural system, logging method, renewal treatment or tending treatment, as described in Section II of Book I.

The centre column contains a code that identifies the treatment as recommended (R), conditionally recommended (CR), or not recommended (NR). The definitions of these terms are:

R = **Recommended:** This activity is ecologically appropriate (it relates well to the biology of the species and the conditions of the site type, and minimizes the potential for damage to the physical environment) and can contribute to the management objectives. Recommended means that the activity can work based on field experience and current knowledge. Recommended does not necessarily suggest that this activity is the best or only option from a biological, ecological or management objective perspective.

CR = **Conditionally Recommended:** This activity is ecologically appropriate (it relates well to the biology of the species and conditions of the site type, and minimizes the potential for damage to the physical environment) and can contribute to the management objectives, **only if the conditions or limitations referenced in the comments section are addressed.** The conditions or limitations in the comments section must be addressed each and every time the activity is referenced in the silvicultural ground rules or in a specific silvicultural treatment package. Otherwise use of the activity will be deemed to be “Not Recommended”, which will trigger the “exception” process. Refer to the FMPM for details on this process.

NR = **Not Recommended:** This activity is not ecologically appropriate (it does not relate well to the biology of the species or the conditions of the site type, or it presents potential for damage to the physical environment), or will not contribute to the management objectives, or is not supported by field experience or current knowledge. Selection of this activity in the silvicultural ground rules or in a specific silvicultural treatment package triggers the “exception” process. Refer to the FMPM for details on this process.

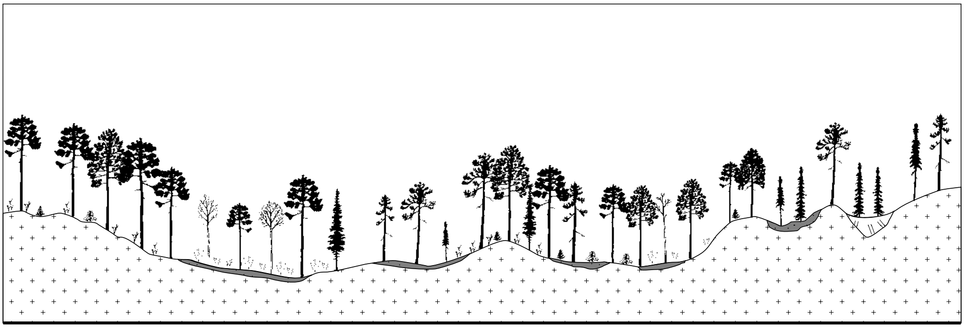
The third column of this table specifies the conditions that must be met if a treatment is conditionally recommended or provides additional information about treatments on this ecosite.

SECTION II

ECOLOGICAL AND MANAGEMENT INTERPRETATIONS

Red Pine–White Pine–Jack Pine: Very Shallow Soil

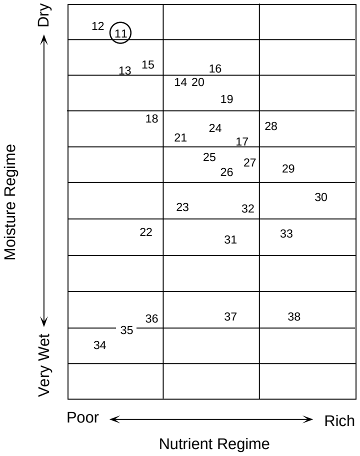
ES 11



approximately 250 m

General Description

Conifer dominated stands with red, white and jack pine. Aspen, large-toothed aspen, white birch and white spruce occur occasionally. White cedar may be locally abundant. Shrub- and herb-poor. Soils very shallow (<20 cm) with bedrock outcrops. Ground cover consists of bedrock, needle litter, feathermoss and lichen.



Soil Types
SS1, SS2, SS3, SS4, SS5

Mode of Deposition
bedrock, morainal

Humus Form
fibrimor

Overstorey
jack pine, red pine, white pine

Shrubs/Trees (<10 m)
Diervilla lonicera, balsam fir, Linnaea borealis, Vaccinium myrtilloides, Vaccinium angustifolium, Arctostaphylos uva-ursi, Rosa acicularis, Juniperus communis

Herbs and Graminoids
Aralia nudicaulis, Maianthemum canadense, Oryzopsis asperifolia, Fragaria virginiana, Aster macrophyllus

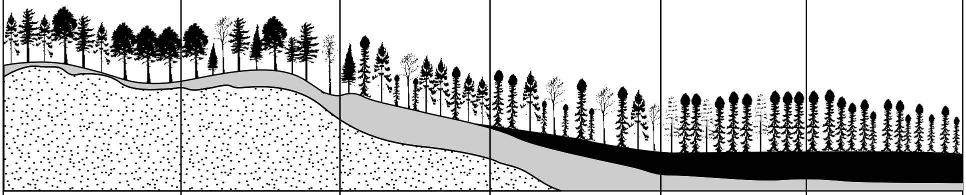
Mosses and Lichens
Pleurozium schreberi, Cladina mitis, Cladina rangiferina, Cladina stellaris, Dicranum polysetum

Comments

May occur as pure stands of red or white pine, or as a mixture of V12, V13, V26, V27, V29 and/or V30. However, due to extremely varied topography, a large number of other V-types and various mixtures of hardwood species may be found in small pockets of deeper soils. S-types SS1 to SS4 are characteristic and dominate (>50% of polygon area), but inclusions of SS5, SS6 and SS9 are frequent.

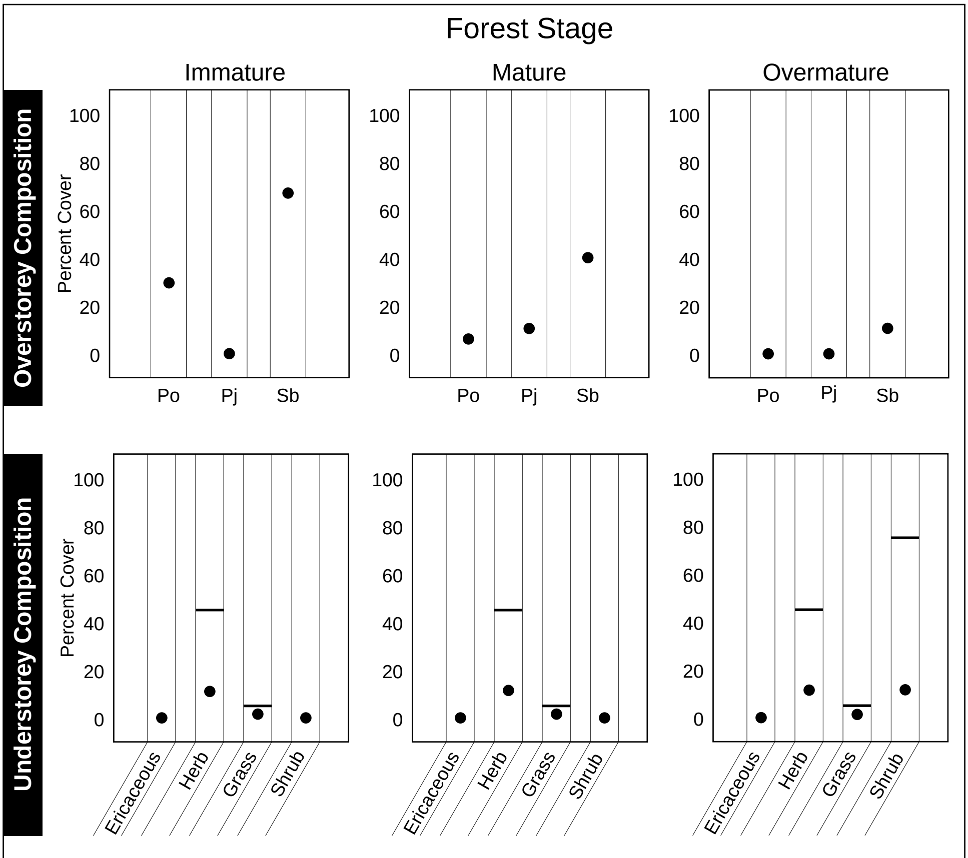
Typical Landscape Associations

Typical Ecosite Sequence on Very Shallow to Deep Coarse Loamy Till Material



Pr-Pw (Pj)	Pw-Pr-Bw (Po)	Pj-Sb (Bf-Bw)	Sb-Bw (Pj)	Sb (Ta)	Sb
ES11 Red Pine- White Pine- Jack Pine: Very Shallow Soil	ES18 Red Pine- White PIne: Fresh, Coarse Loamy Soil	ES20 Spruce-Pine/ Feathermoss: Fresh, Sandy- Coarse Loamy Soil	ES22 Spruce-Pine/ Ledum/ Feathermoss: Moist, Sandy- Coarse Loamy Soil	ES35 Poor Swamp: Black Spruce: Organic Soil	ES34 Treed Bog: Black Spruce/ Sphagnum: Organic Soil
V12 White PIne Mixedwood	V13 Red PIne Mixedwood	V18 Jack Pine Mixedwood/ Feathermoss	V20 Black Spruce Mixedwood/ Feathermoss	V34 Black Spruce/ Labrador-tea/ Feathermoss (Sphagnum)	V38 Black Spruce/ Leatherleaf/ Sphagnum
SS3 Very Shallow Soil On Bedrock	SS6 Shallow- Moderately Deep/ Coarse Loamy	S3 Fresh/ Coarse Loamy	S8 Moist/ Coarse Loamy	S12F Wet/ Organic (Feathermoss)	S12S Wet/Organic (Sphagnum)
Dry	Dry-Fresh	Fresh	Moist	Wet	Wet

Site Structure and Composition



Advance Growth	Forest Stage					
	Immature		Mature		Overmature	
	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)
Sb	N/A	N/A	N/A	N/A	N/A	N/A
Bf	N/A	N/A	N/A	N/A	N/A	N/A

Seedbed															
	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen
	0	39	0	54	7	0	39	54	0	7	0	39	0	54	7

Coarse Woody Debris						
	Logs	Debris	Logs	Debris	Logs	Debris
	N/A	N/A	N/A	N/A	N/A	N/A

Vegetation and Soil Type Relationships

(number of plots with defined combinations)

White Pine Mixedwood 12	Red Pine Mixedwood 13	White Pine Conifer 26	Red Pine Conifer 27	Jack Pine / Ericaceous Shrub / Feathermoss 29	Jack Pine – Black Spruce / Blueberry / Lichen 30		
▨	▨	□	□	□	■		
1		1			4	□	SS1 – Discontinuous Organic Mat on Bedrock
		2		1	3	■	SS2 – Extremely Shallow Soil on Bedrock
	1	1	2	3	11	▨	SS3 – Very Shallow Soil on Bedrock
		1	1			□	SS4 – Very Shallow Soil on Boulder Pavement
	2		1	1	3	▨	SS5 – Shallow – Moderately Deep / Sandy

Description of Soil and Vegetation

- ▨ Characteristic Common
- ■ Common Inclusions
- □ Characteristic Uncommon

Selected Species Habitat Use

Species	Forest Stage					Special Habitat Preferences
	Pre-sapling	Sapling	Immature	Mature	Overmature	
Spruce Grouse						
Great Grey Owl						
Black-backed Woodpecker				●	●	snags
Pileated Woodpecker						
Least Flycatcher						
Boreal Chickadee				○	○	snags
Swainson's Thrush			○	○	○	
Nashville Warbler		○	○	○		high level of light penetration, preferably with shallow undergrowth
Connecticut Warbler						
White-throated Sparrow	○	○			○	numerous openings with low dense vegetation
Northern Flying Squirrel				○	○	snags
Southern Red-backed Vole		○	○	○	○	downed woody debris
Meadow Vole						
Marten						
Woodland Caribou (winter)						
Woodland Caribou (hab. rank)						
White-tailed Deer (forage)						
White-tailed Deer (cover)						
Moose (forage)	○	○				
Moose (cover)						

○ Used Habitat ● Preferred Habitat

Successional Relationships - Natural

This ecosite is characterized by a variable main canopy with a relatively high amount of red pine or white pine. Jack pine, trembling aspen and large tooth aspen occur frequently as codominants in the main canopy although they are shorter-lived. Canopy closure is relatively high in younger stands with older stands exhibiting an open canopy structure. Stand ages commonly range from 40 to 240 years with the majority falling in the 55 to 115 year range.

White birch, and black spruce are common elements in the upper sub-canopy of ES11 although their occurrence and percent cover remains low. White birch, black spruce and white pine are common constituents of the lower sub-canopy at older ages. Balsam fir is also the most frequent species in the sapling layer but rarely enters the tall shrub or sub-canopy layers. Red and jack pine saplings occur approximately one-third of the time where individual tree gaps and windthrow have occurred creating suitable exposed microsites in the understorey.

Succession is towards a more open two-tiered canopy dominated by red and/or white pine with scattered large jack pine. Jack pine, trembling aspen and large-toothed aspen decline in cover as age of the stand increases. Black spruce density and cover increases through time, but is generally restricted to the lower and upper sub-canopies of older stands.

Cover by shrubs such as green alder, serviceberry, prickly wild rose and *Diervilla lonicera* in most stands is low. Tall and low shrub cover within the stand declines further through time, while the occurrence of ericaceous shrubs such as *Vaccinium* spp. increases. Total herb cover is initially low and continues to decline through time. Forest floor cover by *Pleorozium schreberi* increases with time reflecting changes in understorey micro-environment and changes in LFH composition and litter chemistry. In contrast, the presence and mean percent cover of pioneer lichens such as *Cladina* spp. declines through time. Species richness, diversity and evenness show little change over time.

The successional dynamics of these ecosites is dependent upon substrate conditions, fire frequency and intensity, and physiography. Although red pine and white pine cones are not serotinous, fire is critical to their regeneration. Low intensity surface fires during the life of the stand will have two main effects: reduction of woody shrub competition and exposure of a mineral soil seedbed. Continued recruitment of red and white pine into ES11 is greatest in stands where low intensity surface fires occurred every 20 to 40 years, and where the interval between catastrophic crown fires is >100 years. Such conditions generally occur in specific physiographic settings such as exposed ridges and islands in large lakes. The more intense surface fires kill a proportion of mature trees creating gaps in the main canopy and promoting regeneration of red and white pine, and white birch.

Long-term succession (>250 years) will be directed either towards a more open canopy black spruce - ericaceous shrub - feathermoss condition or white pine - feathermoss - *Cladina* spp. in the absence of fires or towards a self-perpetuating red and/or white pine dominated stand.

Successional Relationships - Post-harvest

Response following harvest:

Varying soil conditions on ‘shallow’ sites result in different responses depending on the forest stand conditions present at time of harvest. The presence of a viable red or white pine seed source from residual standards or adjacent stands will contribute to the perpetuation of those species on this ecosite. Jack pine in the original stand will make the likelihood of jack pine ingress greater. An aspen component present in the original canopy is likely to be maintained through vegetative suckering.

Stocking of black spruce and balsam fir in the sub-canopy or as advance growth in the understorey will be greatly reduced following canopy removal due to exposure, sunscald and increased droughtiness of the site.

Response following harvest and mechanical site preparation:

Disturbance and mixing of the LFH with mineral soil will create suitable seedbed for red, white and jack pine. If jack pine is present in the original stand, its presence in the future stand may be enhanced by scarification on the site.

Response following harvest and prescribed fire:

Following clearcutting and fire, the growth of grasses, ericaceous shrubs (blueberry) and herbs (fireweed) is stimulated. These species can quickly dominate the site within two years. Low intensity surface fires will be effective in reducing future competition from woody shrubs and exposing a mineral soil seedbed suitable for conifer establishment. Prescribed fire will destroy any black spruce or balsam fir advance growth and will usually girdle any seedling red and white pine. Moderate to severe intensity surface fires will completely remove the surface organic horizons and kill any hardwood shrubs or aspen present on the cutover.

The application of understorey prescribed fire prior to harvesting can provide an opportunity to create favorable micro-site conditions for red and white pine and reduce the abundance and vigor of non-crop vegetation. Factors affecting the success of this technique in northwestern Ontario include:

- the initial density and crown coverage of the overstorey
- the degree to which the tree canopy has become stratified creating potential fuel ladders
- the timing relative to cone production and seed release
- the density and cover of flammable species such as white birch and balsam fir in the sub-canopy and tall shrub layers, and
- whether it is logistically and financially possible to conduct more than one understorey prescribed burn prior to harvesting

Site Productivity

Site Index by species and NWO FEC Soil Type

Site Index (breast height age 50 years)

Soil Type	Species		
	Sb	Pj	Po
SS1	12.4	10.2	13.2
SS2	N/A	12.2	N/A
SS3	10.6	13.5	11.0
SS4	N/A	N/A	N/A
SS5	10.8	16.2	16.9

Black Spruce Advance Regeneration

	Vegetation Type			
	V12	V13	V26	V27
Stocking (%)	N/A	N/A	N/A	N/A
Stocking Range	N/A	N/A	N/A	N/A
Stems per ha	N/A	N/A	N/A	N/A

V12 and V13 are the characteristic vegetation types. V26 and V27 are common inclusions.

Red pine-white pine dominated vegetation types V12, V13, V26 and V27 were not surveyed for black spruce advance growth. Due to the low density of black spruce in the overstorey, black spruce advance growth is assumed to be low.

Natural Ingress Probability and Density (ten years post-disturbance)

No information available

Critical Comments

- Balsam fir, red maple, beaked hazel, green alder and mountain maple are low to moderate in abundance and well distributed throughout a relatively open understorey when the canopy is dominated by V13 (Red Pine Mixedwoods) and V27 (Red Pine Conifer).
- An abundance of balsam fir, mountain maple and beaked hazel is usually found when the canopy is dominated by V12 (White Pine Mixedwoods) and V26 (White Pine Conifer).
- Older stands with a significant understorey canopy of balsam fir are highly vulnerable to defoliation by the eastern spruce budworm creating potential wildfire hazards and impediments to harvesting and silviculture operations.
- Extremely varied topography often creates deeper soil pockets which will support a variety of other V-types (V29, V30) and various amounts of trembling aspen and white birch.
- *Armillaria* spp. infestations may develop on sites with significant trembling aspen content (V12 V13).
- White pine blister rust *(Cronartium ribicola*) is endemic and may affect white pine on the site.
- Stands containing high proportions of jack pine growing on extremely shallow soils may be vulnerable to jack pine budworm infestations.
- Very shallow soils (< 5 cm) susceptible to nutrient loss, erosion and seasonal drought/dessication.
- Variable shallow soil conditions may limit operability of mechanical site preparation equipment and choice of planting stock.

Site Characteristics, Limitations and Hazard Potential

Characteristics							Limitations				Hazard Potential				
LFH Layer	Soil Texture	Depth to Bedrock	Stoniness	Moisture Regime	Terrain	Competition	Windthrow	Frost Heaving	Drought/Desiccation	Seasonal Flooding	Compaction	Rutting	Soil Erosion	Biomass & Nutrient Removal	Silvicultural Activities
1		3	4		5					7		8	3	1,3	Harvesting
1,2		3	4		5		6		3	7		8	3	1,3	Renewal
		3			5										Tending

Footnotes:

1. Harvesting and renewal activities must limit biomass and nutrient removal.
2. LFH layer is a poor seedbed.
3. Very shallow soils (< 5 cm) susceptible to nutrient loss, erosion, seasonal drought/desiccation.
4. Potential for high surface stone content can limit equipment operability.
5. Access to portions of stand may be limited by complex topography.
6. Shallow rooting zone creates windthrow risk when using strip/patch cut silvicultural system.
7. Seasonal flooding may limit access and equipment operability.
8. Potential rutting hazard on SS9 inclusions.

Opportunities

- May also be managed for red and white pine, under the selection or shelterwood silvicultural system dependant upon density, age and quality of existing pine component.
- Generally lower stocking and densities of non-crop vegetation enables jack pine shelter cones or black spruce mini-plug regeneration options.
- Cone scattering following moderate disturbance of the forest floor via harvesting or mechanical site preparation is an option on those fresher phases of this ecosite supporting high densities of jack pine.
- Planting without site preparation is often preferred on sites with shallow depths of organic matter (< 10 cm).

Silvicultural Intensity Considerations

Species Objective	Site Productivity	Degree of Effort to Reach Free-to-grow
Black spruce	4	3
Jack pine	3 – 4	1 – 2
Aspen	4	N/A

Site Productivity - Site Productivity class (prime land productivity class) based upon height of dominant trees at age 50 years (breast height).

Degree of Effort

1 = Extensive
2 = Basic
3 = Intensive
4 = Highly Intensive

Silvicultural Interpretations for the Establishment of Black Spruce

Silvicultural System **• Harvest Method**		**Comments**
Clearcut		Portions of this site may be classified as 'Protection Forest.'
• Harvest Method - Conventional	R	
- Strip/Block	R	Residual stand will not contribute seed of sufficient quantity. However, this cutting technique is preferred for site protection purposes.
- Patch	R	See Strip/Block comment.
- Seed-tree	NR	Potential for natural seeding is very low due to infrequent occurrence of black spruce in the original stand. Potential for windthrow on this shallow soil also exists.
Shelterwood	NR	Black spruce is mid-tolerant and susceptible to windthrow after thinning of closed canopy stands.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	CR	Full tree is not recommended (NR) where total soil depth (mineral and surface organic) is less than 20 cm. Full tree is permitted on sites where total soil depth exceeds 20 cm provided that a winter harvest is employed or when other measures such as high flotation equipment are used to minimize disturbance of the organic layer.
Tree-length	R	
Cut-to-length/Shortwood	R	
Renewal Treatments		
Site Preparation		Competition is very low.
• Mechanical	CR	Sufficient seedbed may be created as a result of the harvest. Apply techniques that maintain a high percentage of intact forest floor to limit nutrient loss.
• Chemical	R	Shrub and herb poor. Chemical site preparation is generally not required.
• Prescribed Burn	CR	Prescribed fire is conditionally recommended due to potential loss of organic matter and nutrients. Low severity fires which remove ≤ 20% of surface organic material are permissible.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Black Spruce (con't)

Renewal Treatments	Comments	
Regeneration • Natural - Advance Growth	NR	Insufficient data exist. Vegetation types imply low levels of black spruce advance growth on this site.
- Seed	NR	Potential for natural seeding is very low due to infrequent occurrence of black spruce in the original stand.
- Vegetative (coppice)	NR	Black spruce does not coppice.
• Artificial - Planting	R	The number of plantable spots will be limited by soil depth.
- Seeding	NR	This site is prone to seasonal drought which will limit the success of this treatment.
- Scarification	NR	Cone supply is very low due to infrequent occurrence of black spruce in the original stand.
Tending Treatments		
Cleaning		Very low competition and cleaning is generally not required.
• Manual	R	
• Mechanical	R	
• Chemical - Ground	R	
- Aerial	R	
Spacing	R	Juvenile spacing is usually not required since black spruce natural regeneration is minimal.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine

Silvicultural System **• Harvest Method**		**Comments**
Clearcut		Portions of this site may be classified as 'Protection Forest.'
• Harvest Method - Conventional	R	
- Strip/Block	R	Residual stand will not contribute seed of sufficient quantity. However, this cutting technique is preferred for site protection purposes.
- Patch	R	See Strip/Block comment.
- Seed-tree	NR	Jack pine seed tree systems are always used with prescribed fire to secure seed dispersal. Prescribed fire is not recommended on shallow sites due to potential loss of organic material and nutrient capital.
Shelterwood	NR	Jack pine is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	CR	Full tree is not recommended (NR) where total soil depth (mineral and surface organic) is less than 20 cm. Full tree is permitted on sites where total soil depth exceeds 20 cm provided that a winter harvest is employed or when other measures such as high flotation equipment are used to minimize disturbance of the organic layer.
Tree-length	R	
Cut-to-length/Shortwood	R	
Renewal Treatments		
Site Preparation		Very low competition.
• Mechanical	CR	Sufficient seedbed may be created as a result of the harvest. Apply techniques that maintain a high percentage of intact forest floor to limit nutrient loss.
• Chemical	R	Shrub and herb poor. Chemical site preparation is generally not required.
• Prescribed Burn	CR	Prescribed fire is conditionally recommended due to potential loss of organic matter and nutrients. Low severity fires which remove ≤ 20% of surface organic material are permissible.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine (con't)

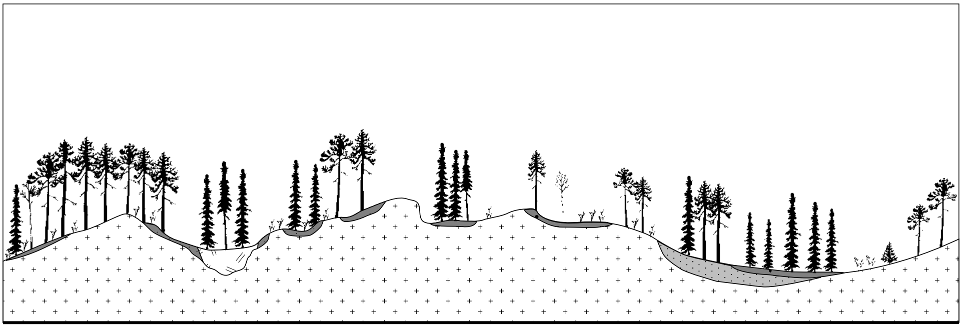
Renewal Treatments	Comments	
Regeneration • Natural - Advance Growth	NR	Jack pine does not regenerate under a closed canopy.
- Seed	NR	Insufficient data exist. Expect low levels of ingress.
- Vegetative (coppice)	NR	Jack pine does not coppice.
• Artificial - Planting	R	The number of plantable spots will be limited by soil depth.
- Seeding	R	Good distribution of mineral soil seedbeds will contribute to success. This site is prone to seasonal drought which will influence the success of this treatment.
- Scarification	NR	Cone supply is very low due to infrequent occurrence of jack pine in the original stand. Regeneration levels associated with cone scattering will be highly variable.
Tending Treatments		
Cleaning		Very low competition and cleaning is generally not required.
• Manual	R	
• Mechanical	R	
• Chemical - Ground	R	
- Aerial	R	
Spacing	R	Spacing is usually not necessary since jack pine natural regeneration is minimal.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

The establishment of aspen is not an appropriate management objective for this site.

Black Spruce–Jack Pine: Very Shallow Soil

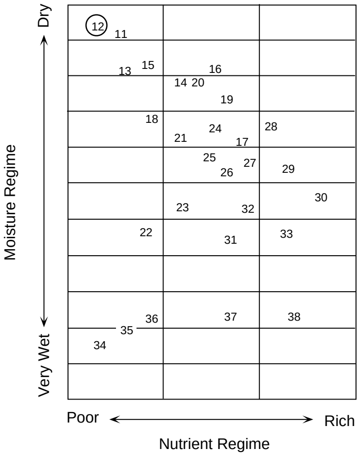
ES 12



approximately 250 m

General Description

Overstorey open and patchy to close-crowned. Dominated by black spruce and jack pine. Balsam fir and trembling aspen in patches. Shrub- and herb-poor. Soils very shallow (<20 cm) with bedrock outcrops. Bedrock frequently covered only by a shallow litter layer. Ground cover consists of bedrock, needle litter, lichen and feathermoss.



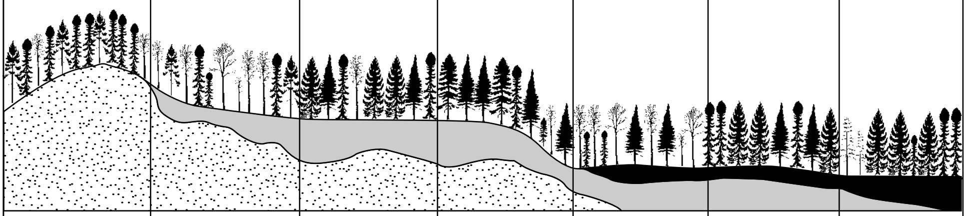
Soil Types
SS1, SS2, SS3, SS4, SS5
Mode of Deposition
bedrock, morainal
Humus Form
fibrimor, humifibrimor
Overstorey
black spruce, jack pine, white birch
Shrubs/Trees (<10 m)
Vaccinium myrtilloides, Vaccinium angustifolium, Gaultheria hispidula, black spruce, balsam fir, Linnaea borealis
Herbs and Graminoids
Aralia nudicaulis, Cornus canadensis, Trientalis borealis, Clintonia borealis, Maianthemum canadense
Mosses and Lichens
Cladina mitis, Cladina rangiferina, Cladina stellaris, Pleurozium schreberi, Ptilium crista-castrensis, Hylocomium splendens, Dicranum polysetum

Comments

May occur as pure jack pine, pure black spruce or as a mixture. May cover small rock outcrops or extensive open bedrock areas. Forest cover may be patchy, with lichen-covered bedrock knobs and ridges. In addition to the characteristic V30, there may be small patches of a wide variety of other V-types, including V35–V38 where drainage is disrupted. White cedar may be locally abundant, especially in the Atikokan, Fort Frances and Dryden areas. Slow tree growth. S-types SS1 to SS4 are characteristic and dominant (>50% of polygon area), but inclusions of SS5, SS6 and SS9 are frequent.

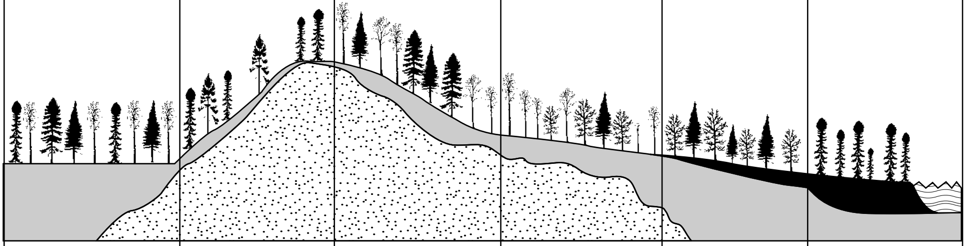
Typical Landscape Associations

Typical Ecosite Sequence on Very Shallow to Deep Coarse Loamy Till Material



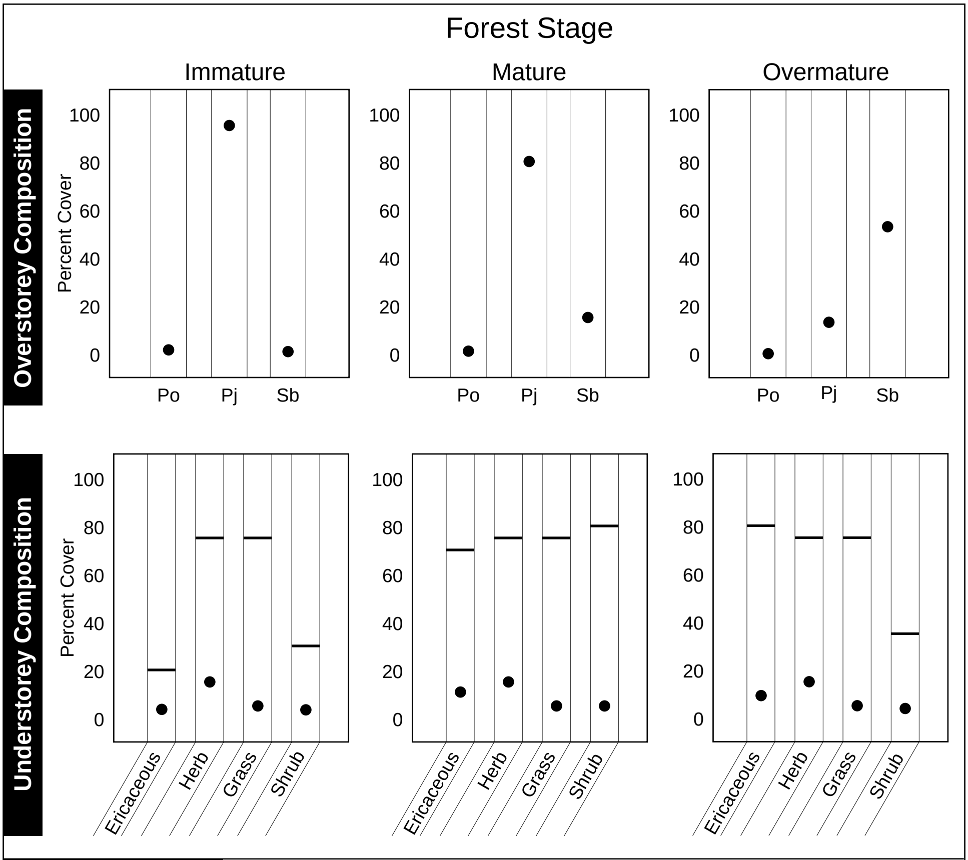
Sb-Pj (Po)	Po-Sb-Pj (Bw)	Ce-Bf (Sb-Po)	Bf-Sw (Po-Sb)	Po-Bf-Bw (Sb)	Ce-Sb (Bf)	Ce-Sb (Ta)
ES12 Black Spruce-Jack Pine: Very Shallow Soil	ES19 Hardwood-Fir-Spruce Mixedwood: Fresh, Sandy-Coarse Loamy Soil	ES17 White Cedar: Fresh-Moist, Coarse-Fine Loamy Soil	ES21 Fir-Spruce Mixedwood: Fresh, Coarse Loamy Soil	ES23 Hardwood-Fir-Spruce Mixedwood: Moist, Sandy-Coarse Loamy Soil	ES17 White Cedar: Fresh-Moist, Coarse-Fine Loamy Soil	ES37 Rich Swamp: Cedar (Other conifer): Organic Soil
V30 Jack Pine-Black Spruce/ Blueberry/Lichen	V11 Trembling Aspen-Conifer/Blueberry/ Feathermoss	V21 Cedar (inc. Mixedwood)/ Mountain Maple	V16 Balsam Fir-White Spruce Mixedwood/ Feathermoss	V6 Trembling Aspen (White Birch)-Balsam Fir/ Mountain Maple	V21 Cedar (inc. Mixedwood)/ Mountain Maple	V22 Cedar (inc. Mixedwood)/ Speckled Alder/ Sphagnum
SS2 Exremely Shallow Soil on Bedrock	SS6 Shallow-Moderately Deep/ Coarse Loamy	S3 Fresh/ Coarse Loamy	S3 Fresh/ Coarse Loamy	S8 Moist/ Coarse Loamy	S8 Moist/ Coarse Loamy	S12S Wet/Organic (Sphagnum)
Dry	Dry-Fresh	Fresh	Fresh	Moist	Moist	Wet

Typical Ecosite Sequence on Very Shallow to Deep Silty to Clayey Glaciolacustrine Material



Po-Bf-Sw (Sb)	Sb-Pj	Po-Sw (Bf-Bw)	Ab-Po-Bw (Bf)	Ab (Bf)	Sb
ES33 Hardwood-Fir-Spruce Mixedwood: Moist, Silty-Clayey Soil	ES12 Black Spruce-Jack Pine: Very Shallow Soil	ES29 Hardwood-Fir-Spruce Mixedwood: Fresh, Fine Loamy-Clayey Soil	ES30 Black Ash Hardwood: Fresh, Silty-Clayey Soil	ES38 Rich Swamp: Black Ash (Other Hardwood): Organic-Mineral Soil	ES36 Intermediate Swamp: Black Spruce, (Tamarack): Organic Soil
V7 Trembling Aspen-Balsam Fir/ Balsam Fir Shrub	V30 Jack Pine-Black Spruce/ Blueberry/Lichen	V9 Trembling Aspen Mixedwood	V2 Black Ash Hardwood and Mixedwood	V2 Black Ash Hardwood and Mixedwood	V35 Black Spruce/ Speckled Alder/ Sphagnum
S10 Moist/Fine Loamy-Clayey	SS2 Extremely Shallow Soil on Bedrock	SS7 Shallow-Moderately Deep/ Silty-Fine Loamy-Clayey	S10 Moist/Fine Loamy-Clayey	S12F Wet/Organic (Feathermoss)	S12S Wet/Organic (Sphagnum)
Moist	Dry	Fresh	Moist	Wet	Wet

Site Structure and Composition



Advance Growth	Forest Stage					
	Immature		Mature		Overmature	
	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)
Sb	25	N/A	1237	N/A	782	N/A
Bf	1038	N/A	2449	N/A	1002	N/A

Seedbed															
	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen
	28	42	1	20	9	28	42	1	20	9	28	42	1	20	9

Coarse Woody Debris						
	Logs	Debris	Logs	Debris	Logs	Debris
	N/A	N/A	N/A	N/A	N/A	N/A

Vegetation and Soil Type Relationships

(number of plots with defined combinations)

Description of Soil and Vegetation

▒	Characteristic Common
■	Common Inclusions
□	Characteristic Uncommon

30 Jack Pine – Black Spruce / Blueberry / Lichen	35 Black Spruce / Speckled Alder / Sphagnum	36 Black Spruce / Bunchberry / Sphagnum (Feathermoss)	37 Black Spruce / Ericaceous Shrub / Sphagnum	38 Black Spruce / Leatherleaf / Sphagnum		
▒	□	□	□	□		
4					□	SS1 – Discontinuous Organic Mat on Bedrock
3			1		■	SS2 – Extremely Shallow Soil on Bedrock
11					▒	SS3 – Very Shallow Soil on Bedrock
			1		□	SS4 – Very Shallow Soil on Boulder Pavement
3					■	SS5 – Shallow – Moderately Deep / Sandy

Selected Species Habitat Use

Species	Forest Stage					Special Habitat Preferences
	Pre-sapling	Sapling	Immature	Mature	Overmature	
Spruce Grouse			○	○	○	
Great Grey Owl						
Black-backed Woodpecker				●	●	snags
Pileated Woodpecker				○	○	snags, downed woody debris
Least Flycatcher						
Boreal Chickadee				○	○	snags
Swainson's Thrush			○	○	○	
Nashville Warbler		○	○	○		high level of light penetration, preferably with shallow undergrowth
Connecticut Warbler						
White-throated Sparrow	○	○			○	numerous openings with low dense vegetation
Northern Flying Squirrel				○	○	snags
Southern Red-backed Vole		○	○	○	○	downed woody debris
Meadow Vole						
Marten						
Woodland Caribou (winter)			○	●	●	arboreal lichens
Woodland Caribou (hab. rank)	○	○	●	●	●	
White-tailed Deer (forage)						
White-tailed Deer (cover)						
Moose (forage)	○	○				
Moose (cover)						

○ Used Habitat ● Preferred Habitat

Successional Relationships - Natural

This ecosite is characterized by an overstorey of black spruce and/or jack pine. An intermittent sub-canopy of white birch and pockets of balsam fir are often found in association with moderately deep to deep pockets of mineral soil. The understorey is generally open with scattered clumps of black spruce in the shrub layers. The understorey is characteristically dominated by *Pleurozium schreberi* - feathermoss and ericaceous shrubs such as *Vaccinium* spp. Very shallow soils with areas of exposed bedrock have a significant *Cladina* spp. lichen cover. Regeneration and recruitment into the sub-canopy is usually sparse, with black spruce predominating. Balsam fir and black spruce saplings are relatively common in those stands with a higher percent crown closure. Stands possessing this structure generally range in age from 55 to 100 years.

Given the relatively shorter lifespan of jack pine, succession on these sites is towards black spruce. Total canopy tree cover declines through time. Recruitment of black spruce into the main canopy is slow. This is one of the few ecosites where regeneration of jack pine in the understorey will occur in openings and gaps created by canopy break-up. Remnant jack pine and the occasional white birch may occur in older stands dominated by black spruce.

Tall and low shrub cover will decline over time. The exception is *Vaccinium angustifolium* and *Linnaea borealis* which retain their presence and relatively high abundance in the low shrub layer. Total herb cover is generally less than that of shrubs and also declines, particularly in older stands. *Pleurozium schreberi* - feathermoss cover on the forest floor increases over time at the expense of *Cladina* spp. lichens and/or bare rock and mineral soil substrates. The club lichens (*Cladonia* spp.) are less frequent and generally occur at low cover. Species richness, diversity and evenness show little change over time.

The overall successional trajectory for this ecosite is clear. Long-term succession (>100 years) is towards a more open canopy black spruce (jack pine) - feathermoss condition although the rate at which this happens varies considerably between sites. In the absence of strong regeneration, these black spruce-jack pine stands on very shallow soil conditions become more open and savannah-like. Regeneration patterns of black spruce are strongly dependent upon seed source proximity and whether the site experiences non-lethal, surface fires beneath the original canopy. The successional dynamics of these sites is dependent upon substrate conditions, fire frequency and intensity, and physiography.

Successional Relationships - Post-harvest

Response following harvest:

Varying soil conditions on ‘shallow’ sites result in different responses depending on the forest stand conditions present at time of harvest. The presence of a viable black spruce or jack pine seed source from residual standards or adjacent stands will contribute to the perpetuation of those species on this ecosite. Jack pine in the original stand will make the likelihood of jack pine ingress greater. An aspen component present in the original canopy is likely to be maintained through vegetative suckering.

The probability of natural ingress from both jack pine and black spruce ten-years following disturbance from logging is high. Shallow soils and irregular terrain create a range of micro-sites, increasing chances for successful germination of a number of tree species. Likewise a high probability exists for black spruce advance growth to occur in the understorey in the undisturbed stand. Stocking of black spruce and balsam fir in the sub-canopy or as advance growth in the understorey will be greatly reduced following canopy removal due to exposure, sunscald and increased droughtiness of the site. This effect will be accentuated on knobs and ridgetops.

Proliferation of woody shrubs is uncommon but the presence and cover of ericaceous shrubs in deeper soil pockets will be enhanced. Exposed feathermoss quickly dies following removal of the overstorey.

Response following harvest and mechanical site preparation:

Disturbance and mixing of the LFH with mineral soil will create suitable seedbed for black spruce and jack pine. If jack pine is present in the original stand, its presence in the future stand may be enhanced by scarification on the site. An increase in drought resistant graminoids.

Response following harvest and prescribed fire:

Following fire, the growth of grasses, ericaceous shrubs (blueberry) and herbs (fireweed) is stimulated. These species can quickly dominate the site within two years. Low intensity surface fires will be effective in reducing future competition from woody shrubs and exposing a mineral soil seedbed suitable for conifer establishment. Prescribed fire will destroy any black spruce or balsam fir advance growth and will usually girdle any seedling jack pine. Moderate to severe intensity surface fires will completely remove the surface organic horizons and kill any hardwood shrubs or aspen present on the cutover.

Site Productivity

Site Index by species and NWO FEC Soil Type

Site Index (breast height age 50 years)

Soil Type	Species		
	Sb	Pj	Po
SS1	12.4	10.2	12.2
SS2	N/A	12.2	N/A
SS3	10.6	13.5	11.0
SS4	N/A	N/A	N/A
SS5	10.8	16.2	16.9

Black Spruce Advance Regeneration

	Vegetation Type
	V30
Stocking (%)	34
Stocking Range	0 – 75
Stems per ha	5700

V30 is the characteristic vegetation type.

This ecosite can be dominated by black spruce or jack pine.

Where black spruce is the dominant species, advance growth will be moderate to high.

The number and distribution of black spruce advance growth on this ecosite is positively related to:

- basal area of black spruce in the original stand

and inversely related to:

- percent cover of herbaceous species
- percent cover of broadleaf litter
- percent canopy closure

Natural Ingress Probability and Density (ten years post-disturbance)

Seedbed Condition	Species and Height Class					
	Sb		Pj		Po	
	< 1.0	> 1.0	< 1.0	> 1.0	< 1.0	> 1.0
Duff	X ▒	H ▒	X ▒	X ▓	H ░	H ░
Mineral Soil	Insufficient Data					
Burned	Insufficient Data					

Probability Class

V- < 21%
L- 21 - 40%
M- 41 - 60%
H- 61 - 80%
X- > 80%

Density Class

⬜ < 300
░ 300 - 1000
▒ 1001 - 5000
▓ 5001 - 10000
█ > 10000

- Shallow soils and irregular terrain create a range of microsites, thus increasing the chances for successful germination of a number of species.
- On knobs and ridgetops, drought may be a limiting factor to seedling establishment. Black spruce seed trees on these microsites distribute seed to lower slope positions where moisture regimes are better for germination.
- Natural regeneration of jack pine will be enhanced by mineral soil exposure or a light scraping of the feathermoss.

Critical Comments

- Stands containing high proportions of jack pine growing on extremely shallow soils may be vulnerable to jack pine budworm infestations.
- Very shallow soils (< 5 cm) susceptible to nutrient loss, erosion and seasonal drought/dessication.
- Variable shallow soil conditions may limit operability of mechanical site preparation equipment and choice of planting stock.

Site Characteristics, Limitations and Hazard Potential

Characteristics							Limitations				Hazard Potential				
LFH Layer	Soil Texture	Depth to Bedrock	Stoniness	Moisture Regime	Terrain	Competition	Windthrow	Frost Heaving	Drought/Desiccation	Seasonal Flooding	Compaction	Rutting	Soil Erosion	Biomass & Nutrient Removal	Silvicultural Activities
1		3	4		5					7		8	3	1,3	Harvesting
1,2		3	4		5		6		3	7		8	3	1,3	Renewal
		3			5										Tending

Footnotes:

1. Harvesting and renewal activities must limit biomass and nutrient removal.
2. LFH layer is a poor seedbed.
3. Very shallow soils (< 5 cm) susceptible to nutrient loss, erosion, seasonal drought/desiccation.
4. Potential for high surface stone content can limit equipment operability.
5. Access to portions of stand may be limited by complex topography.
6. Shallow rooting zone creates windthrow risk when using strip/patch cut silvicultural system.
7. Seasonal flooding may limit access and equipment operability.
8. Potential rutting hazard on SS9 inclusions.

Opportunities

- Physical site factors identical to ES11, although forest cover type distinctions may result in differing biological processes and hence silvicultural options.
- Site productivity potential for individual jack pine and black spruce is high although stand level productivity may be less due to site limitations to stocking and site utilization.
- Opportunities same as ES11, however, expect greater amounts of black spruce advance growth and natural regeneration from seed of both jack pine and black spruce. Consider leaving mature clumps of black spruce in low windthrow hazard areas to augment natural ingress.
- Generally lower stocking and densities of non-crop vegetation enables jack pine shelter cones or black spruce mini-plug regeneration options.
- Opportunity for boot-screefing and/or direct planting through the thin LFH layer as an alterntive to mechanical site preparation.

Silvicultural Intensity Considerations

Species Objective	Site Productivity	Degree of Effort to Reach Free-to-grow
Black spruce	4	3
Jack pine	3 – 4	1 – 2
Aspen	4	N/A

Site Productivity - Site Productivity class (prime land productivity class) based upon height of dominant trees at age 50 years (breast height).

Degree of Effort

1 = Extensive
2 = Basic
3 = Intensive
4 = Highly Intensive

Silvicultural Interpretations for the Establishment of Black Spruce

Silvicultural System **• Harvest Method**	**Comments**	
Clearcut		Portions of this site may be classified as 'Protection Forest.'
• Harvest Method - Conventional	R	
- Strip/Block	CR	An assessment of seedbed quality and the quality and quantity of black spruce parent trees in the leave strip is necessary to determine potential of this treatment. Strip width should be less than 40 m due to soil moisture regime. This cutting technique may also be prescribed to meet other management objectives. Windthrow may be a hazard on this site.
- Patch	CR	An assessment of seedbed quality and the quality and quantity of black spruce parent trees in the leave patch is necessary to determine potential of this treatment. Careful consideration must be given to the size and configuration of patches due to soil moisture regime. This cutting technique may also be prescribed to meet other management objectives. Windthrow may be a hazard on this site.
- Seed-tree	NR	Potential for seasonal drought will limit success of this treatment. Windthrow may be a hazard on this site.
Shelterwood	NR	Black spruce is mid-tolerant and susceptible to windthrow after thinning of closed canopy stands.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	CR	Full tree is not recommended (NR) where total soil depth (mineral and surface organic) is less than 20 cm. Full tree is permitted on sites where total soil depth exceeds 20 cm provided that a winter harvest is employed or when other measures such as high flotation equipment are used to minimize disturbance of the organic layer.
Tree-length	R	
Cut-to-length/Shortwood	R	

= Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Black Spruce (con't)

Renewal Treatments	Comments	
Site Preparation		Very low competition on this site.
• Mechanical	CR	Sufficient seedbed may be created as a result of the harvest. Apply techniques that maintain a high percentage of intact forest floor to limit the loss of nutrients.
• Chemical	R	Shrub and herb poor. Chemical site preparation is generally not required.
• Prescribed Burn	CR	Prescribed fire is conditionally recommended due to potential loss of organic matter and nutrients. Low severity fires which remove ≤ 20% of surface organic material are permissible.
Regeneration • Natural - Advance Growth	R	Moderate levels of advance growth. May require supplemental artificial regeneration.
- Seed	R	Moderate levels of black spruce ingress. May require supplemental artificial regeneration. Potential for seasonal drought on this site may limit success of this treatment.
- Vegetative (coppice)	NR	Black spruce does not coppice.
• Artificial - Planting	R	The number of plantable spots will be limited by soil depth.
- Seeding	NR	This site is prone to seasonal drought which will influence the success of this treatment.
- Scarification	NR	The quantity, distribution and retention of suitable microsites will limit the success of this treatment.
Tending Treatments		
Cleaning		Very low competition and cleaning is generally not required.
• Manual	R	
• Mechanical	R	
• Chemical - Ground	R	
- Aerial	R	
Spacing	R	Spacing is usually not necessary since black spruce natural regeneration is minimal.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine

Silvicultural System **• Harvest Method**	**Comments**	
Clearcut		Portions of this site may be classified as ‘Protection Forest.’
• Harvest Method - Conventional	R	
- Strip/Block	R	Residual stand will not contribute seed of sufficient quantity. However, this cutting technique is preferred for site protection purposes.
- Patch	R	See Strip/Block comment.
- Seed-tree	NR	Jack pine seed tree systems are used in conjunction with prescribed fire. Prescribed fire is not recommended due to potential loss of nutrient capital on these shallow sites.
Shelterwood	NR	Jack pine is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	CR	Full tree is not recommended (NR) where total soil depth (mineral and surface organic) is less than 20 cm. Full tree is permitted on sites where total soil depth exceeds 20 cm provided that a winter harvest is employed or when other measures such as high flotation equipment are used to minimize disturbance of the organic layer. No restrictions apply on moderately deep to deep (SS5, SS6, SS9) soils where mineral soil depth exceeds 30 cm and the thickness of the surface organic layer is > 5 cm.
Tree-length	R	
Cut-to-length/Shortwood	R	
Renewal Treatments		
Site Preparation		Very low competition on this site.
• Mechanical	CR	Sufficient seedbed may be created as a result of the harvest. Apply techniques that maintain a high percentage of intact forest floor to limit the loss of nutrients.
• Chemical	R	Shrub and herb poor. Chemical site preparation is generally not required.
• Prescribed Burn	CR	Prescribed fire is conditionally recommended due to potential loss of organic matter and nutrients. Low severity fires which remove ≤ 20% of surface organic material are permissible.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine (con't)

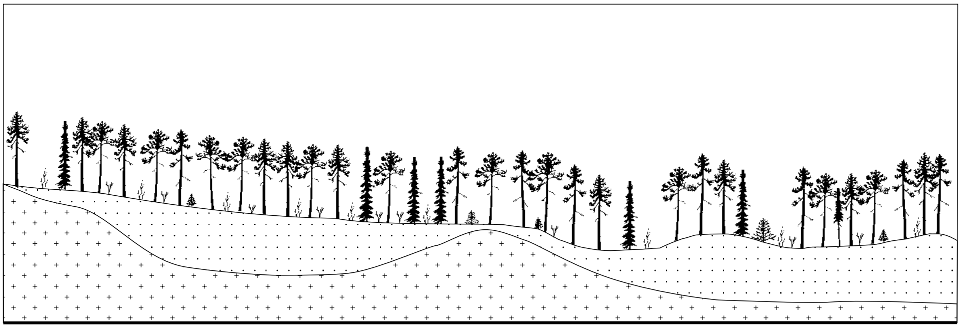
Renewal Treatments	Comments	
Regeneration		
• Natural		
- Advance Growth	NR	Jack pine does not regenerate under a closed canopy.
- Seed	R	Moderate to high levels of ingress. Supplemental artificial regeneration may be required.
- Vegetative (coppice)	NR	Jack pine does not coppice.
• Artificial		
- Planting	R	The number of plantable spots will be limited by soil depth. Natural seed and/or seeding are preferred options, as natural ingress will override density and distribution control objectives associated with planting.
- Seeding	R	Good distribution of mineral soil seedbeds will contribute to success. This site is prone to seasonal drought which will influence the success of this treatment.
- Scarification	R	Insufficient data exist. Site conditions imply high levels of ingress.
Tending Treatments		
Cleaning		Very low competition and cleaning is generally not required.
• Manual	R	
• Mechanical	R	
• Chemical		
- Ground	R	
- Aerial	R	
Spacing	R	Spacing is usually not necessary since jack pine natural regeneration is well distributed.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

The establishment of aspen is not an appropriate management objective for this site.

Jack Pine–Conifer: Dry–Moderately Fresh, Sandy Soil

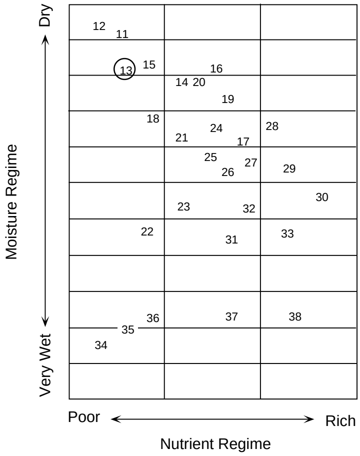
ES 13



approximately 250 m

General Description

Jack pine dominated, often consisting of even-aged stands. Black spruce sparse to abundant, white birch and trembling aspen may be present. Feathermoss abundant under closed canopy; replaced by lichens under open canopy. Soils dry to moderately fresh, rapidly to well drained, coarse to fine sandy. Predominantly on glaciofluvial or lacustrine parent materials. Ground cover consists of feathermoss, lichen and conifer litter.



Soil Types
S1, S2, SS5

Mode of Deposition
glaciofluvial, lacustrine, morainal

Humus Form
fibrimor, humifibrimor, raw moder

Overstorey
jack pine, black spruce

Shrubs/Trees (<10 m)
Vaccinium myrtilloides, Vaccinium angustifolium, Linnaea borealis, Diervilla lonicera, Rosa acicularis, Corylus cornuta, Alnus viridis, Amelanchier spp., Arctostaphylos uva-ursi

Herbs and Graminoids
Maianthemum canadense, Cornus canadensis, Aralia nudicaulis, Melampyrum lineare, Clintonia borealis

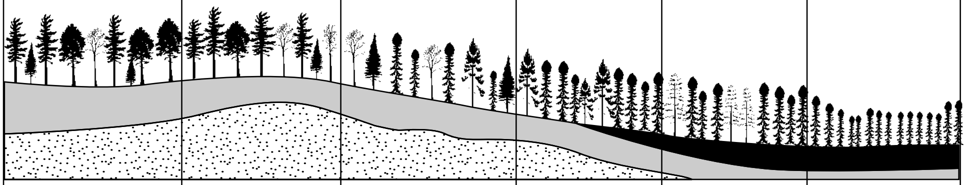
Mosses and Lichens
Pleurozium schreberi, Dicranum polysetum, Cladina rangiferina, Cladina mitis, Cladina stellaris

Comments

A deep soil, homogeneous, jack pine dominated ecosite with V28–V30 characteristic; but expect to see local patches of V32 and V33, and rarely V34. Black spruce component increases with age of stand. Topography typically rolling, sometimes including dune formations.

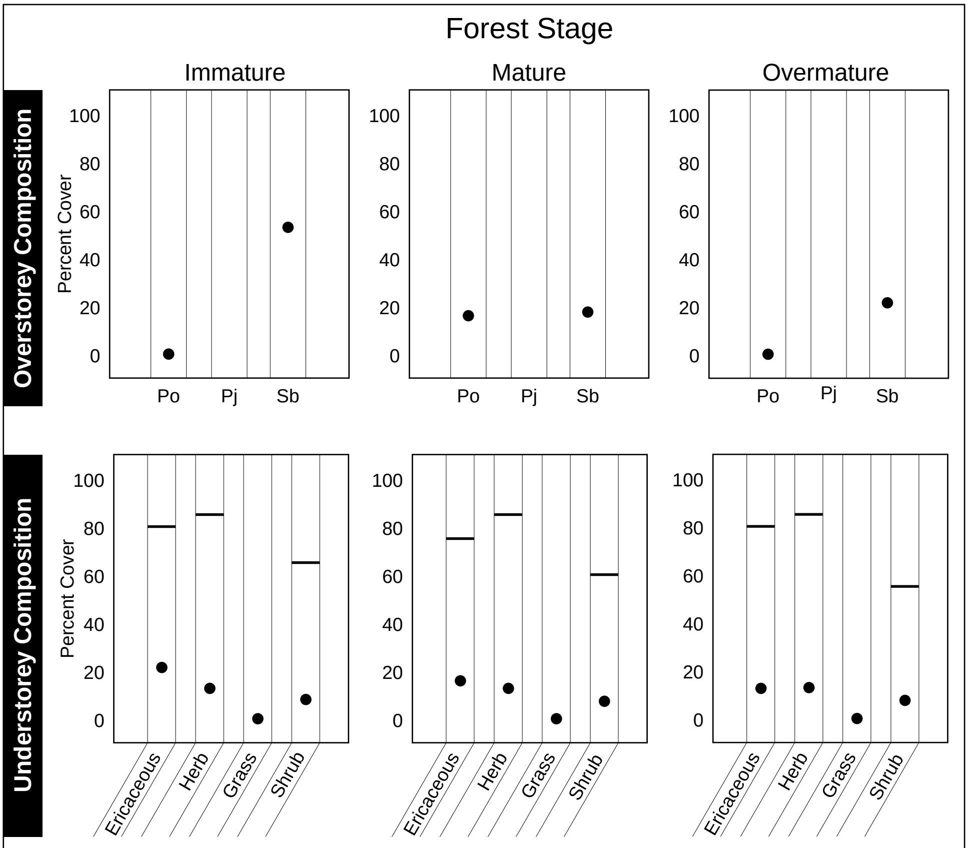
Typical Landscape Associations

Typical Ecosite Sequence on Sandy Glaciofluvial Soil Material



Pr-Pw	Pr-Pw-Pw	Sb-Bw-Pj (Bf)	Sb (Pj)	Sb -Ta	Stunted Sb
ES15 Red Pine-White Pine: Sandy Soil	ES15 Red Pine-White Pine: Sandy Soil	ES14 Pine-Spruce Mixedwood: Sandy Soil	ES22 Spruce-Pine/ Ledum/ Feathermoss: Moist, Sandy-Coarse Loamy Soil	ES36 Intermediate Swamp: Black Spruce (Tamarack): Organic Soil	ES34 Treed Bog: Black Spruce/ Sphagnum: Organic Soil
V27 Red Pine Conifer	V12 White Pine Mixedwood	V18 Jack Pine Mixedwood/ Feathermoss	V33 Black Spruce Feathermoss	V23 Tamarack (Black Spruce)/ Speckled Alder/ Labrador-tea	V38 Black Spruce/ Leatherleaf/ Sphagnum
S1 Dry/ Coarse Sandy	S2 Fresh/ Fine Sandy	S2 Fresh/ Fine Sandy	S7 Moist/Sandy	S12F Wet/Organic (Feathermoss)	S12S Wet/Organic (Sphagnum)
Dry	Dry	Moderately Fresh	Moist	Wet	Wet

Site Structure and Composition



Advance Growth

Forest Stage

	Immature		Mature		Overmature	
	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)
Sb	3405	N/A	1326	N/A	1726	N/A
Bf	1474	N/A	4057	N/A	2993	N/A

Seedbed

	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen
	15	39	0	40	6	15	39	4	36	6	15	39	0	40	6

Coarse Woody Debris

	Logs	Debris	Logs	Debris	Logs	Debris
	N/A	N/A	N/A	N/A	N/A	N/A

Vegetation and Soil Type Relationships
(number of plots with defined combinations)

Jack Pine / Low Shrub 28	Jack Pine / Ericaceous Shrub Feathermoss 29	Jack Pine – Black Spruce / Blueberry / Lichen 30	Jack Pine – Black Spruce / Ericaceous Shrub / Feathermoss 32	Black Spruce / Feathermoss 33		
▒	▒	▒	▒	□		
13	17	3	40	7	▒	S1 – Dry / Coarse Sandy
2	23	7	30	14	▒	S2 – Fresh / Fine Sandy
2	1	3	3	5	□	SS5 – Shallow – Moderately Deep / Sandy

Description of Soil and Vegetation
- ▒ Characteristic Common
- ■ Common Inclusions
- □ Characteristic Uncommon

Selected Species Habitat Use

Species	Forest Stage					Special Habitat Preferences
	Pre-sapling	Sapling	Immature	Mature	Overmature	
Spruce Grouse			●	●	○	
Great Grey Owl						
Black-backed Woodpecker				●	●	snags
Pileated Woodpecker						
Least Flycatcher						
Boreal Chickadee				○	○	snags
Swainson's Thrush			○	○	○	
Nashville Warbler		○	○	○		high level of light penetration, preferably with shallow undergrowth
Connecticut Warbler						
White-throated Sparrow	○	○			○	numerous openings with low dense vegetation
Northern Flying Squirrel				○	○	snags
Southern Red-backed Vole		○	○	○	○	downed woody debris
Meadow Vole						
Marten			○	●	●	snags, downed woody debris
Woodland Caribou (winter)			○	●	●	arboreal lichens
Woodland Caribou (hab. rank)	○	○	●	●	●	
White-tailed Deer (forage)						
White-tailed Deer (cover)						
Moose (forage)	○	○				
Moose (cover)			○	○	○	

○ Used Habitat ● Preferred Habitat

Successional Relationships - Natural

This ecosite is characterized by a contiguous but somewhat open overstorey of even-aged jack pine with the occasional black spruce in either the main or sub-canopy. Scattered white birch and trembling aspen may also be present. The understorey is generally open without a discernable sub-canopy or tall shrub layer. Balsam fir and black spruce saplings are relatively common as are saplings of ‘pioneer’ tree species such as white birch, trembling aspen and jack pine. However, these saplings rarely move into the low or tall shrub strata. The understorey is characteristically dominated by *Pleurozium schreberi* - feathermoss and ericaceous shrubs such as *Vaccinium* spp. Areas of forest floor receiving direct solar radiation often have a significant *Cladina* spp. lichen cover. Regeneration and recruitment into the sub-canopy is usually sparse, with black spruce predominating. Stands range in age from 41 to 212 years, with the majority being between 55 to 100 years.

Given the relatively shorter lifespan of jack pine, succession on these sites is often but not always towards black spruce. Total canopy tree cover declines through time; recruitment of black spruce into the main canopy is slow to none-existent. This is one of the few ecosites where regeneration of jack pine in the understorey will occur in openings and gaps created by canopy break-up. Remnant jack pine and the occasional white birch may occur in older stands.

Tall and low shrub cover will decline over time although low shrub cover is generally moderate to high throughout the stand’s development. *Vaccinium angustifolium and V. myrtilloides* are ubiquitous. *Diervilla lonicera*, *Chimaphila umbellata*, *Rosa acicularis*, and *Arctostaphylos urva-ursi* are less common but often occur with a relatively high abundance in the low shrub layer when present. Total herb cover is generally less than that of shrubs and also declines, particularly in older stands. *Pleurozium schreberi* - feather moss cover on the forest floor increases over time at the expense of *Cladina* spp. lichens. Species richness, diversity and evenness show little change over time.

The overall successional trajectory for this ecosite is clear. Long-term succession (>100 years) is towards a more open canopy black spruce (jack pine) - feathermoss condition although the rate at which this happens varies considerably between sites. In the absence of strong regeneration, these black spruce-jack pine stands on very dry sandy soils become more open and savannah-like. Regeneration patterns of black spruce are strongly dependent upon seed source proximity and whether the site experiences non-lethal, surface fires beneath the original canopy. The successional dynamics of these sites is dependent upon substrate conditions, fire frequency and intensity, and physiography.

Successional Relationships - Post-harvest

Response following harvest:

The presence of a viable black spruce or jack pine seed source from residuals or adjacent stands will contribute to the perpetuation of those species on this ecosite. Jack pine in the original stand will make the likelihood of jack pine ingress greater.

The probability of natural ingress for jack pine ten years after disturbance from logging is high. In fact, ingress is complete for jack pine eight years following disturbance, and more than half of this is established within two years. Shallow forest litter matts coupled with logging disturbance creates a range of micro-sites, increasing chances for successful germination of a number of tree species. Mineral soil exposure extends the time to achieve full ingress for both black spruce and jack pine.

A low probability exists for black spruce advance growth to occur in the understorey in the undisturbed stand. Stocking of any black spruce and balsam fir in the sub-canopy or as advance growth in the understorey will be greatly reduced following canopy removal due to exposure, sunscald and increased droughtiness of the site. This effect will be accentuated on knobs and ridgetops.

Proliferation of woody shrubs is uncommon but the presence and cover of ericaceous shrubs in deeper soil pockets will be enhanced. Exposed feathermoss quickly dies following removal of the overstorey.

Response following harvest and mechanical site preparation:

Disturbance and mixing of the LFH with mineral soil will create suitable seedbed for black spruce and jack pine. If jack pine is present in the original stand, its presence in the future stand may be enhanced by scarification on the site. An increase in drought resistant graminoids is often encountered on this very dry ecosite.

Response following harvest and prescribed fire:

Following fire, the growth of fine-bladed, drought resistant grasses, ericaceous shrubs (blueberry) and herbs (fireweed) is stimulated. These species can quickly dominate the site within two years. Low intensity surface fires will be effective in reducing future competition from woody shrubs and exposing a mineral soil seedbed suitable for conifer establishment. Prescribed fire will destroy any black spruce or balsam fir advance growth and will usually girdle any seedling jack pine. Moderate to severe intensity surface fires will completely remove the surface organic horizons and kill any hardwood shrubs or aspen present on the cutover.

Site Productivity

Site Index by species and NWO FEC Soil Type

Site Index (breast height age 50 years)

Soil Type	Species		
	Sb	Pj	Po
S1	13.0	18.3	19.3
S2	11.9	16.9	20.1
SS5	10.8	16.2	16.9

Black Spruce Advance Regeneration

	Vegetation Type			
	V28	V29	V30	V32
Stocking (%)	6	34	34	32
Stocking Range	0 – 30	5 – 70	0 – 75	0 – 80
Stems per ha	300	4700	5700	3100

V28, V29 and V32 are the characteristic vegetation types with V30 as a common inclusion.

This ecosite is dominated by jack pine but may include black spruce.

This ecosite has a low probability of sufficient number and distribution of black spruce advance growth to regenerate the site.

The number and distribution of black spruce advance growth on this ecosite is positively related to:

- black spruce basal area in the original stand

and inversely related to:

- percent canopy closure

Natural Ingress Probability and Density (ten years post-disturbance)

Seedbed Condition	Species and Height Class					
	Sb		Pj		Po	
	< 1.0	> 1.0	< 1.0	> 1.0	< 1.0	> 1.0
Duff	L ░	M ▒	X ▓	X ▉	M ░	M ▒
Mineral Soil	H ░	L ░	X ▓	X ▉	L ░	L ░
Burned	Insufficient Data					

Probability Class

V- < 21%
L- 21 - 40%
M- 41 - 60%
H- 61 - 80%
X- > 80%

Density Class

░ < 300
▒ 300 - 1000
▓ 1001 - 5000
▉ 5001 - 10000
█ > 10000

- Jack pine natural regeneration dominates this ecosite. Ingress is complete eight years after disturbance, and more than half of this is established within two years after disturbance.
- Ingress of black spruce is similar to that of jack pine, but aspen establishment is slower.
- Mineral soil exposure extends the time to achieve full ingress for both black spruce and aspen, i.e. suitable seedbeds are “held” longer.

Critical Comments

- Moderate levels of competition can be expected from green alder, willow, *Calamagrostis candensis* and trembling aspen (the latter if present in the initial stand). The alder and willow may provide suitable ‘nurse crop’ coverage preventing dessication of the forest floor and available seedbed.
- Stands containing a high proportion of black spruce growing on deep, dry to fresh, rapidly-drained coarse to fine sands may be susceptible to *Armillaria* spp. and *Inonutus tomentosus*.
- Stands containing a high proportion of black spruce growing on deep, dry to fresh, rapidly-drained coarse to fine sands are moderately susceptible to spruce budworm infestation.
- Harvesting and renewal activities located on aeolian deposits (sand dunes) which expose substantial areas of mineral soil may create active soil transport (saltation).

Site Characteristics, Limitations and Hazard Potential

Characteristics							Limitations				Hazard Potential				
LFH Layer	Soil Texture	Depth to Bedrock	Stoniness	Moisture Regime	Terrain	Competition	Windthrow	Frost Heaving	Drought/Desiccation	Seasonal Flooding	Compaction	Rutting	Soil Erosion	Biomass & Nutrient Removal	Silvicultural Activities
1	3													1	Harvesting
1,2	3			4					4					1	Renewal
	3														Tending

Footnotes:

1. Harvesting and renewal activities must limit biomass and nutrient removal.
2. LFH layer is a poor seedbed.
3. Coarse textured soils are nutrient poor.
4. Dry moisture regime prone to seasonal drought/desiccation.

Opportunities

- Ingress of natural jack pine after harvest and site preparation is generally high, therefore planting usually not necessary. Cone/slash scattering methods produce good results.
- These are good sites for direct seeding (precision or broadcast) of jack pine. Precision seeding methods offer a lower cost alternate treatment where initial density control is desired.
- Low intensity mechanical site preparation (*e.g*. light drags) or prescribed fire can provide receptive seedbed. Suitable mineral soil or mixed organic-mineral soil seedbeds persists for several years due to low amounts of non-crop herbaceous vegetation.
- Jack pine seed trees (minimum 20/ha) in conjunction with prescribed fire offers a cost-effective regeneration strategy on these sites.
- Black spruce advance growth may be present on occasional sites in sufficient quantities that it will contribute significantly to regeneration targets.
- Management objectives for this ecosite could include production of red pine poles, particularly on those soils with a fresh moisture regime.
- These ecosites are ideal for blueberry production.
- Jack pine responds well to pre-commercial thinning to shorten crop rotation length.

Silvicultural Intensity Considerations

Species Objective	Site Productivity	Degree of Effort to Reach Free-to-grow
Black spruce	3	3
Jack pine	2	1
Aspen	3	N/A

Site Productivity - Site Productivity class (prime land productivity class) based upon height of dominant trees at age 50 years (breast height).

Degree of Effort

1 = Extensive
2 = Basic
3 = Intensive
4 = Highly Intensive

Silvicultural Interpretations for the Establishment of Black Spruce

Silvicultural System **• Harvest Method**		**Comments**
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	CR	An assessment of seedbed quality and the quality and quantity of black spruce parent trees in the leave strip is necessary to determine potential of this treatment. Strip width should be less than 40 m due to soil moisture regime. This cutting technique may also be prescribed to meet other management objectives.
- Patch	CR	An assessment of seedbed quality and the quality and quantity of black spruce parent trees in the leave patch is necessary to determine potential of this treatment. Careful consideration must be given to the size and configuration of patches due to soil moisture regime. This cutting technique may also be prescribed to meet other management objectives.
- Seed-tree	NR	Potential for seasonal drought will limit success of this treatment.
Shelterwood	NR	Black spruce is mid-tolerant and susceptible to windthrow after thinning of closed canopy stands.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	CR	Full tree harvesting is conditionally recommended provided that "best practices" are used to minimize disturbance of the surface organic layer. Where surface organic thickness averages < 5 cm, winter harvest and/or use of high flotation equipment should be considered to maintain the integrity of the surface organic layer.
Tree-length	R	Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	R	See Tree-length comment.

R = Recommended **CR = Conditionally Recommended** **NR = Not Recommended**

Silvicultural Interpretations for the Establishment of Black Spruce (con't)

Renewal Treatments		Comments
Site Preparation		Low competition on this site.
• Mechanical	CR	Apply techniques that maintain a high percentage of intact forest floor to limit the loss of nutrients.
• Chemical	R	Shrub and herb poor. Chemical site preparation is generally not required.
• Prescribed Burn	CR	Prescribed fire is conditionally recommended due to potential loss of organic matter and nutrients. Low to moderate severity fire which removes ≤ 50% of the surface organic layer is permissible and will result in the creation of suitable seedbed/plantable spots.
Regeneration • Natural - Advance Growth	NR	Black spruce advance growth is not of sufficient quantity or distribution to regenerate the site.
- Seed	NR	Low levels of black spruce ingress.
- Vegetative (coppice)	NR	Black spruce does not coppice.
• Artificial - Planting	R	
- Seeding	NR	Seeding success is reduced on sandy soils. Xeric to dry moisture regimes will further limit success.
- Scarification	NR	Limited cone supply. The quantity, distribution and retention of suitable microsites limits the success of this treatment. Low levels of black spruce ingress.
Tending Treatments		
Cleaning		Low competition and cleaning is generally not required.
• Manual	R	
• Mechanical	R	
• Chemical - Ground	R	
- Aerial	R	
Spacing	R	Spacing of black spruce is usually not necessary, but may be required where levels of jack pine ingress are high.

R = Recommended **CR = Conditionally Recommended** **NR = Not Recommended**

Silvicultural Interpretations for the Establishment of Jack Pine

Silvicultural System **• Harvest Method**		**Comments**
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	R	Residual stand will not contribute seed of sufficient quantity or genetic quality. However, this cutting technique may be prescribed to meet other management objectives.
- Patch	R	See Strip/Block comment.
- Seed-tree	CR	Use prescribed fires of low to moderate severity to open cones and prepare a receptive seedbed.
Shelterwood	NR	Jack pine is shade intolerant and is generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	CR	Full tree harvesting is conditionally recommended provided that "best practices" are used to minimize disturbance of the surface organic layer. Where surface organic thickness averages < 5 cm, winter harvest and/or use of high flotation equipment should be considered to maintain the integrity of the surface organic layer.
Tree-length	R	Tree length is the preferred logging method. Leaving cone-bearing tops on site will contribute to success of natural seeding/scarification treatments for jack pine. See Cut-to-length/Shortwood comment.
Cut-to-length/Shortwood	R	Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Renewal Treatments		
Site Preparation		Low competition on this site.
• Mechanical	CR	Apply techniques that maintain a high percentage of intact forest floor to limit the loss of nutrients. A good distribution of mineral soil seedbeds created by mechanical site preparation will contribute to successful natural and/or direct seeding.
• Chemical	R	Shrub and herb poor. Chemical site preparation is generally not required.

R = Recommended **CR = Conditionally Recommended** **NR = Not Recommended**

Silvicultural Interpretations for the Establishment of Jack Pine (con't)

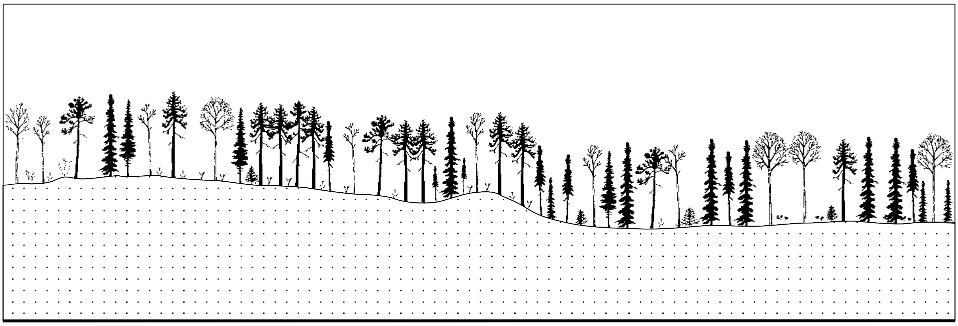
Renewal Treatments	**Comments**	
• Prescribed Burn	CR	Prescribed fire is conditionally recommended due to potential loss of organic matter and nutrients. Low to moderate severity fire which removes ≤ 50% of the surface organic layer is permissible and will result in the creation of suitable seedbed/plantable spots.
Regeneration • Natural - Advance Growth	NR	Jack pine does not regenerate under a closed canopy.
- Seed	R	High level of jack pine ingress. Mineral soil exposure is required for successful treatment. Potential for seasonal drought may limit success of this treatment.
- Vegetative (coppice)	NR	Jack pine does not coppice.
• Artificial - Planting	R	Natural seed and/or seeding are preferred options. Ingress will override density and distribution control objectives associated with planting.
- Seeding	R	This technique is successful with adequate distribution of receptive seedbeds. Precision/direct seeding will assist in density regulation. This site is prone to seasonal drought which will influence the success of this treatment.
- Scarification	R	Good distribution of mineral soil seedbeds will contribute to regeneration success from cone scattering. This site is prone to seasonal drought which will influence the success of this treatment.
Tending Treatments		
Cleaning		Low competition on this site, and cleaning is generally not required.
• Manual	R	
• Mechanical	R	
• Chemical - Ground	R	
- Aerial	R	
Spacing	R	Spacing may be required when using natural or artificial seeding techniques.

R = Recommended **CR = Conditionally Recommended** **NR = Not Recommended**

The establishment of aspen is not an appropriate management objective for this site.

Pine–Spruce Mixedwood: Sandy Soil

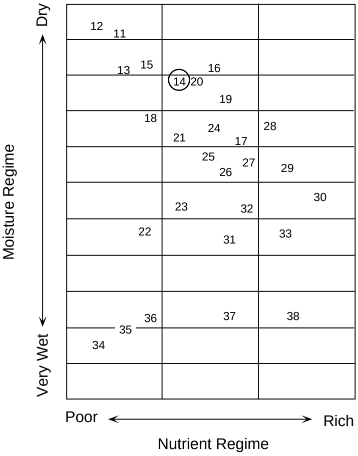
ES 14



approximately 250 m

General Description

Overstorey dominated by jack pine and black spruce with mixtures of white birch and aspen. Understorey variable but usually abundant herbs and shrubs. On deeper sites, soils moderately dry to moderately fresh, rapidly to well drained, coarse to fine sandy. On shallow to moderately deep sites, soils predominantly morainal. Ground cover consists of feathermoss, conifer and broadleaf litter.



Soil Types
S1, S2, SS5

Mode of Deposition
glaciofluvial, morainal

Humus Form
fibrimor, humifibrimor

Overstorey
jack pine, black spruce, trembling aspen, white birch, balsam fir, white spruce

Shrubs/Trees (<10 m)
Acer spicatum, Corylus cornuta, Diervilla lonicera, Rubus pubescens, Alnus viridis, balsam fir, white spruce, white birch, trembling aspen, Linnaea borealis, Rosa acicularis, Vaccinium spp., black spruce

Herbs and Graminoids
Aster macrophyllus, Streptopus roseus, Aralia nudicaulis, Clintonia borealis, Trientalis borealis, Viola renifolia, Maianthemum canadense, Cornus canadensis, Lycopodium spp.

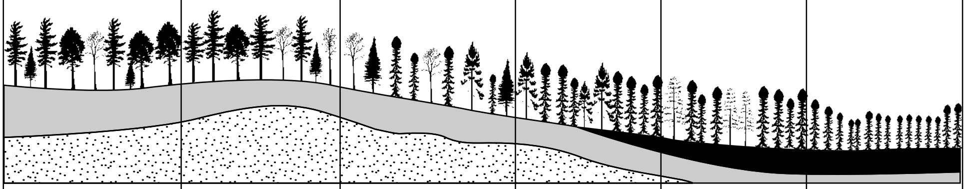
Mosses and Lichens
Pleurozium schreberi, Ptilium crista-castrensis, Hylocomium splendens, Dicranum polysetum

Comments

Characteristic V-types include V17–V20. Local variations include V10 and V31–V33, with occurrence of these V-types increasing with age. Landform types variable from sand plains to rolling terrain with moderately deep soils over bedrock, eskers and other glaciofluvial deposits.

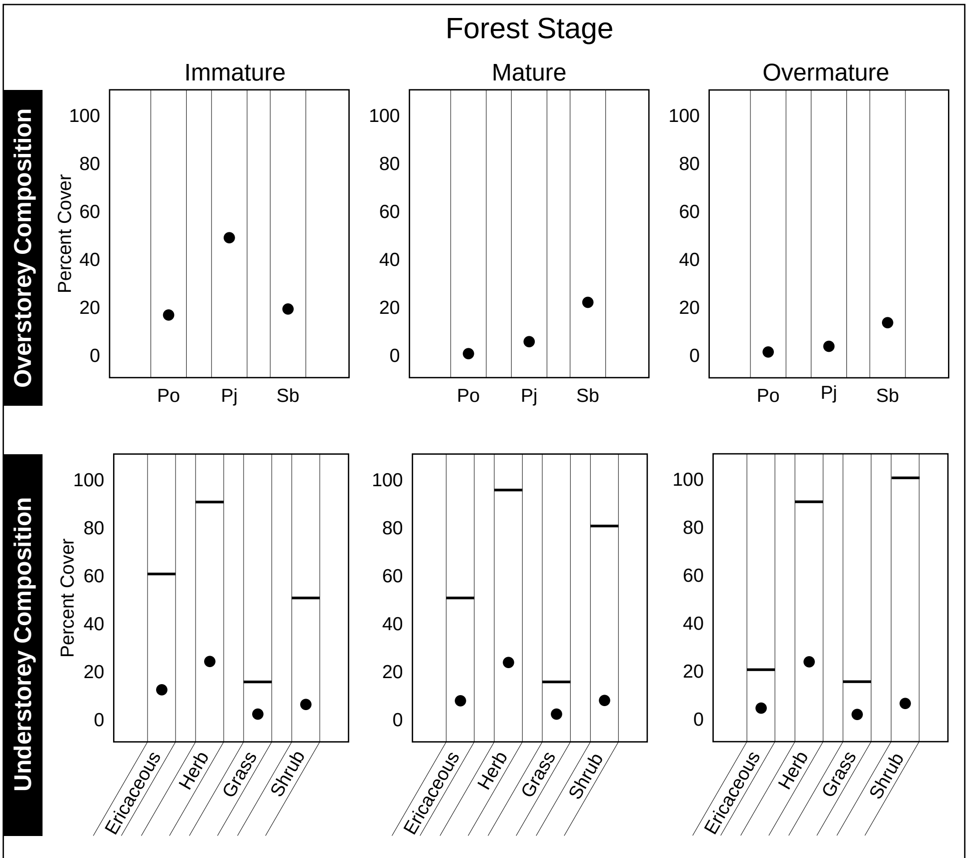
Typical Landscape Associations

Typical Ecosite Sequence on Sandy Glaciofluvial Soil Material



Pr-Pw	Pr-Pw-Pw	Sb-Bw-Pj (Bf)	Sb (Pj)	Sb -Ta	Stunted Sb
ES15 Red Pine-White Pine: Sandy Soil	ES15 Red Pine-White Pine: Sandy Soil	ES14 Pine-Spruce Mixedwood: Sandy Soil	ES22 Spruce-Pine/ Ledum/ Feathermoss: Moist, Sandy-Coarse Loamy Soil	ES36 Intermediate Swamp: Black Spruce (Tamarack): Organic Soil	ES34 Treed Bog: Black Spruce/ Sphagnum: Organic Soil
V27 Red Pine Conifer	V12 White Pine Mixedwood	V18 Jack Pine Mixedwood/ Feathermoss	V33 Black Spruce/ Feathermoss	V23 Tamarack (Black Spruce)/ Speckled Alder/ Labrador-tea	V38 Black Spruce/ Leatherleaf/ Sphagnum
S1 Dry/ Coarse Sandy	S2 Fresh/ Fine Sandy	S2 Fresh/ Fine Sandy	S7 Moist/Sandy	S12F Wet/Organic (Feathermoss)	S12S Wet/Organic (Sphagnum)
Dry	Dry	Moderately Fresh	Moist	Wet	Wet

Site Structure and Composition



Advance Growth

Forest Stage

	Immature		Mature		Overmature	
	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)
Sb	3164	N/A	3513	N/A	1906	N/A
Bf	3309	N/A	1668	N/A	1440	N/A

Seedbed

	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen
	0	24	10	63	3	0	24	0	73	3	0	24	0	73	3

Coarse Woody Debris

	Logs	Debris	Logs	Debris	Logs	Debris
	N/A	N/A	N/A	N/A	N/A	N/A

Vegetation and Soil Type Relationships
(number of plots with defined combinations)

17 Jack Pine Mixedwood / Shrub Rich	18 Jack Pine Mixedwood / Feathermoss	19 Black Spruce Mixedwood / Herb Rich	20 Black Spruce Mixedwood / Feathermoss	31 Black Spruce – Jack Pine / Tall Shrub / Feathermoss	32 Jack Pine – Black Spruce / Ericaceous Shrub / Feathermoss	33 Black Spruce / Feathermoss		
▨	▨	▨	▨	□	□	□		
21	24	6	10	8	40	7	▨	S1 – Dry / Coarse Sandy
10	14	5	3	14	30	14	▨	S2 – Fresh / Fine Sandy
2	2	2	7	1	3	5	□	SS5 – Shallow – Moderately Deep / Sandy

Description of Soil and Vegetation
- ▨ Characteristic Common
- ■ Common Inclusions
- □ Characteristic Uncommon

Selected Species Habitat Use

Species	Forest Stage Pre-sapling	 Sapling	 Immature	 Mature	 Overmature	Special Habitat Preferences
Spruce Grouse			●	●	○	
Great Grey Owl						
Black-backed Woodpecker				●	●	snags
Pileated Woodpecker						
Least Flycatcher						
Boreal Chickadee				○	○	snags
Swainson's Thrush			○	○	○	
Nashville Warbler		○	○	○		high level of light penetration, preferably with shallow undergrowth
Connecticut Warbler						
White-throated Sparrow	○	○			○	numerous openings with low dense vegetation
Northern Flying Squirrel				○	○	snags
Southern Red-backed Vole		○	○	○	○	downed woody debris
Meadow Vole						
Marten			○	●	●	snags, downed woody debris
Woodland Caribou (winter)				○	○	arboreal lichens
Woodland Caribou (hab. rank)			●	●	●	
White-tailed Deer (forage)						
White-tailed Deer (cover)						
Moose (forage)	○	○				
Moose (cover)			○	○	○	

○ Used Habitat ● Preferred Habitat

Successional Relationships - Natural

This ecosite is characterized by a closed, mixed jack pine - black spruce canopy with mixtures of white birch and trembling aspen. Jack pine is almost exclusively found in the canopy, whereas black spruce is distributed throughout the canopy, sub-canopy and sapling layers. Jack pine recruitment is restricted to the first few years after fire while black spruce recruitment continues for at least 60 years post catastrophic disturbance. White birch, balsam fir, trembling aspen and/or white spruce may be occasionally present in the two sub-canopies, but they are uncommon. Stand ages range from 45 to 186 years with the majority of sites occurring between 70 to 115 years of age.

Total shrub cover is low, and tall shrubs such as *Acer spicatum, Alnus viridis* and *Corylus cornuta* predominate. Low shrubs include *Vaccinium* spp. and *Diervilla lonicera*. Non-ericaceous shrubs and herbs occur with low frequency and/or cover. The forest floor is primarily covered by *Pleurozium schreberi* although *Dicranum polysetum* and *Ptilium crista-cristensis* are also frequent. Species richness, diversity and evenness are low compared to the other ecosites.

The successional trajectory indicates increased dominance by black spruce, in both the canopy and sub-canopy layers. Unlike ES12, black spruce recruitment into the stand remains strong and total canopy cover does not declines over time. Recruitment of black spruce is initially contemporaneous with jack pine and then becomes gradual or episodic. Episodic recruitment usually follows low-intensity surface fire. This results in a dense, uneven-aged monodominant black spruce stand. Some relict jack pine may occur in older stands. White birch which may show moderate to strong regeneration in more open canopy sites and/or in areas of windthrow, persists in some older stands.

Tall and low shrub cover will decline over time after 100 years as canopy closure is maintained. Herb cover declines steadily. Moss species continue to dominate the forest floor. The exception is *Vaccinium angustifolium* and *Linnaea borealis* which retain their presence and relatively high abundance in the low shrub layer. Total herb cover is generally less than that of shrubs and also declines, particularly in older stands .

Successional Relationships - Post-harvest

Response following harvest:

The presence of a viable black spruce or jack pine seed source from residuals or adjacent stands will contribute to the perpetuation of those species on this ecosite. Jack pine in the original stand will make the likelihood of jack pine ingress greater. An aspen component present in the original canopy is likely to be maintained through vegetative suckering.

The probability of natural ingress both jack pine, black spruce and trembling aspen eight years following disturbance from logging is high. Jack pine ingress is complete eight years following disturbance and removal of the canopy. Fifty percent of the ingress establishes itself within two years after disturbance. In contrast, black spruce has an extended period of establishment reflecting the fact that suitable seedbed disappears faster on this ecosite due to non-crop vegetation.

A low probability exists for black spruce advance growth to occur in the understorey in the undisturbed stand. Stocking of black spruce and balsam fir in the sub-canopy or as advance growth in the understorey will be greatly reduced following canopy removal due to exposure, sunscald and increased droughtiness of the site.

Proliferation of woody shrubs is uncommon but the presence and cover of ericaceous shrubs in deeper soil pockets will be enhanced. Exposed feathermoss quickly dies following removal of the overstorey.

Response following harvest and mechanical site preparation:

Disturbance and mixing of the LFH with mineral soil will create suitable seedbed for black spruce and jack pine. If jack pine is present in the original stand, its presence in the future stand may be enhanced by scarification on the site. Soil disturbance will stimulate the establishment and growth of woody shrubs and will stimulate hardwood suckering especially from aspen. Buried branch parts will root and revegetate new plants. Ericaceous shrubs will increase in abundance by sprouting from rhizomes.

Response following harvest and prescribed fire:

Following fire, the growth of ericaceous shrubs (blueberry) and herbs (fireweed) is stimulated. These species can quickly dominate the site within two years. Moderate to high intensity surface fires will be effective in reducing future competition from woody shrubs and exposing a mineral soil seedbed suitable for conifer establishment. Prescribed fire will destroy any black spruce or balsam fir advance growth and will usually girdle any seedling jack pine. Moderate to severe intensity surface fires will completely remove the surface organic horizons and kill any hardwood shrubs or aspen present on the cutover.

Ericaceous shrubs will sprout following light intensity fires but sprouting is suppressed by high intensity, severe fires.

Site Productivity

Site Index by species and NWO FEC Soil Type
Site Index (breast height age 50 years)

Soil Type	Species		
	Sb	Pj	Po
S1	13.0	18.3	19.3
S2	11.9	16.9	20.1
SS5	10.8	16.2	16.9

Black Spruce Advance Regeneration

	Vegetation Type			
	V17	V18	V31	V32
Stocking (%)	15	27	19	32
Stocking Range	0 – 35	5 – 85	0 – 55	0 – 80
Stems per ha	1100	3600	1000	3100

V17, V18 are the characteristic vegetation types with V31 and V32 as common inclusions.

These ecosites are dominated by jack pine and black spruce with mixtures of trembling aspen and white birch.

This ecosite has a low probability of sufficient number and distribution of black spruce advance growth to regenerate the site.

The number and distribution of black spruce advance growth on this ecosite is positively related to:

- basal area of black spruce in the original stand

and inversely related to:

- percent cover of herbaceous species
- percent cover of broadleaf litter
- percent canopy closure

Natural Ingress Probability and Density (ten years post-disturbance)

Seedbed Condition	Species and Height Class					
	Sb		Pj		Po	
	< 1.0	> 1.0	< 1.0	> 1.0	< 1.0	> 1.0
Duff	H ▓	H ▒	X ▒	X ▩	H ▒	X ▓
Mineral Soil	X ▓	X ▓	X ▓	X █	H ▓	X ▓
Burned	Insufficient Data					

Probability Class

V- < 21%
L- 21 - 40%
M- 41 - 60%
H- 61 - 80%
X- > 80%

Density Class

░ < 300
▒ 300 - 1000
▓ 1001 - 5000
▩ 5001 - 10000
█ > 10000

- Ingress patterns are similar to those on ES13. Jack pine is the dominant ingress species, followed by aspen and black spruce.
- In contrast to ES13, mineral soil exposure tends to increase ingress density on ES14.
- Time to achieve full ingress for black spruce and aspen is slightly less compared to ES13. This may indicate that suitable seedbed disappears faster on this ecosite compared to the low-competition ES13.

Critical Comments

- Moderate to high levels of competition from green alder, mountain maple, beaked hazel and aspen may occur when the stand is mature to over-mature and gaps exist in the canopy permitting the development of these species in the understorey. Excessive disturbance of residual stems will enhance the stocking and density of non-crop vegetation on the site.
- Stands may be prone to jack pine budworm.
- Exposed seedbeds may be prone to seasonal drought limiting natural regeneration of black spruce.

Site Characteristics, Limitations and Hazard Potential

Characteristics								Limitations				Hazard Potential			
LFH Layer	Soil Texture	Depth to Bedrock	Stoniness	Moisture Regime	Terrain	Competition	Windthrow	Frost Heaving	Drought/Desiccation	Seasonal Flooding	Compaction	Rutting	Soil Erosion	Biomass & Nutrient Removal	Silvicultural Activities
1	3													1	Harvesting
1,2	3			4					4					1	Renewal
	3														Tending

Footnotes:

1. Harvesting and renewal activities must limit biomass and nutrient removal.
2. LFH layer is a poor seedbed.
3. Coarse textured soils are nutrient poor.
4. Dry moisture regime prone to seasonal drought/desiccation.
5. Moderate to high competition with mountain maple, beaked hazel and aspen as the principle competitors.

Opportunities

- Objectives for this ecosite could include the white birch, red pine, or white pine working groups.
- White spruce can be successfully regenerated on the moderately deep, fresh to very fresh SS5 .
- Ingress of natural jack pine after harvest and site preparation is generally high, therefore planting usually not necessary. Cone/slash scattering methods produce good results. Some degree of organic matter disturbance is required.
- Direct seeding (precision or broadcast) of jack pine is highly successful on this ecosite. Precision seeding methods offer a lower cost alternate treatment where initial density control is desired.
- Low intensity mechanical site preparation (e.g. light drags) or prescribed fire can provide receptive seedbed. Suitable mineral soil or mixed organic-mineral soil seedbeds persists for several years due to low amounts of non-crop herbaceous vegetation.
- Jack pine and black spruce seed trees (minimum 20/ha) in conjunction with prescribed fire offer a cost-effective regeneration strategy on these sites.
- Opportunity for boot-screefing and/or direct planting through the thin LFH layer as an alternative to mechanical site preparation. Planting black spruce or jack pine without site preparation is possible.

Silvicultural Intensity Considerations

Species Objective	Site Productivity	Degree of Effort to Reach Free-to-grow
Black spruce	3	3
Jack pine	2	1 – 2
Aspen	3	1

Degree of Effort

1 = Extensive
2 = Basic
3 = Intensive
4 = Highly Intensive

Site Productivity - Site Productivity class (prime land productivity class) based upon height of dominant trees at age 50 years (breast height).

Silvicultural Interpretations for the Establishment of Black Spruce

Silvicultural System **• Harvest Method**	**Comments**	
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	CR	An assessment of seedbed quality and the quality and quantity of black spruce parent trees in the leave strip is necessary to determine potential of this treatment. Strip width should be less than 40 m due to soil moisture regime. This cutting technique may also be prescribed to meet other management objectives.
- Patch	CR	An assessment of seedbed quality and the quality and quantity of black spruce parent trees in the leave patch is necessary to determine potential of this treatment. Careful consideration must be given to the size and configuration of patches due to soil moisture regime. This cutting technique may also be prescribed to meet other management objectives.
- Seed-tree	CR	Group seed tree is the most commonly used technique. Individual seed tree to be used only in conjunction with prescribed fire. Ensure there is adequate distribution of black spruce in the portion of the stand where seed tree system is being prescribed.
Shelterwood	NR	Black spruce is mid-tolerant and susceptible to windthrow after thinning of closed canopy stands.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	CR	Full tree harvesting is conditionally recommended provided that "best practices" are used to minimize disturbance and/or displacement of the surface organic layer.
Tree-length	R	Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	R	See Tree-length comment.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Black Spruce (con't)

Renewal Treatments		Comments
Site Preparation		Moderate to high competition on this site.
• Mechanical	CR	Apply techniques that maintain a high percentage of intact forest floor to limit the loss of nutrients.
• Chemical	R	Assess the abundance of black spruce advance growth and its potential importance to the renewal strategy for this site. Some herbicide-resistant non-crop species may occur on this site.
• Prescribed Burn	CR	Prescribed fire is conditionally recommended due to potential loss of organic matter and nutrients. Low to moderate severity fire which removes ≤ 50% of the surface organic layer is permissible and will result in the creation of suitable seedbed/plantable spots.
Regeneration • Natural - Advance Growth	R	Moderate levels of advance growth. May require supplemental artificial regeneration.
- Seed	NR	Low levels of black spruce ingress.
- Vegetative (coppice)	NR	Black spruce does not coppice.
• Artificial - Planting	R	
- Seeding	NR	A dry moisture regime and smothering of seedbeds with hardwood litter will limit success. Seeding success is reduced on sandy soils.
- Scarification	NR	Low levels of black spruce ingress. Insufficient cone supply and difficulty in retaining sufficient amounts of suitable microsites limits success of this treatment.
Tending Treatments		
Cleaning		Competition is moderate to high on this site.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing is usually not necessary since black spruce natural regeneration is minimal.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine

Silvicultural System **• Harvest Method**		**Comments**
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	R	Residual stand will not contribute seed of sufficient quantity or genetic quality. However, this cutting technique may be prescribed to meet other management objectives.
- Patch	R	See Strip/Block comment.
- Seed-tree	CR	Assess the abundance of potential jack pine seed trees in the overstorey. Use prescribed fire of moderate severity to open cones and prepare receptive seedbeds.
Shelterwood	NR	Jack pine is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	CR	Full tree harvesting is conditionally recommended provided that "best practices" are used to minimize disturbance and/or displacement of the surface organic layer.
Tree-length	R	Tree length is the preferred logging method on this site. Leaving cone-bearing tops on site will contribute to success of natural seeding/scarification treatments for jack pine. See Cut-to-Length/Shortwood comment.
Cut-to-length/Shortwood	R	Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Renewal Treatments		
Site Preparation		Moderate to high competition on this site.
• Mechanical	CR	Apply techniques that maintain a high percentage of intact forest floor to limit the loss of nutrients. Good distribution of mineral soil seedbeds created by mechanical site preparation will contribute to success natural and/or direct seeding.
• Chemical	R	Some herbicide-resistant non-crop species may occur on this site.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine (con't)

Renewal Treatments		Comments
• Prescribed Burn	CR	Prescribed fire is conditionally recommended due to potential loss of organic matter and nutrients. Low to moderate severity fire which removes ≤ 50% of the surface organic layer is permissible and will result in the creation of suitable seedbed/plantable spots.
Regeneration • Natural - Advance Growth	NR	Jack pine does not regenerate under a closed canopy.
- Seed	R	High levels of jack pine ingress. Distribution of receptive seedbeds will determine treatment success.
-Vegetative (coppice)	NR	Jack pine does not coppice.
• Artificial - Planting	R	Natural seed and/or seeding are preferred options. Ingress will override density and distribution control objectives associated with planting.
- Seeding	R	Good distribution of mineral soil seedbeds will contribute to success. This site is prone to seasonal drought which will influence the success of this treatment.
- Scarification	R	High levels of jack pine ingress. Excessive disturbance of the L and F layers will encourage competitors.
Tending Treatments		
Cleaning		Moderate to high competition on this site.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of competitors.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing will be beneficial where jack pine density is high from natural or direct seeding.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Aspen

Silvicultural System • Harvest Method	Comments	
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	CR	Strips should be at least 20 m wide to warm the soil and stimulate suckering. Strip cutting can also be prescribed to meet other management objectives.
- Patch	CR	Openings 0.4 ha in size are the minimum acceptable to stimulate aspen suckering. Patch cutting can also be prescribed to meet other management objectives.
- Seed-tree	NR	Leaving live aspen will reduce suckering.
Shelterwood	NR	Aspen is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	CR	Full tree harvesting is conditionally recommended provided that "best practices" are used to minimize disturbance and/or displacement of the surface organic layer.
Tree-length	R	Slash remaining on the site will reduce soil temperature and sucker production.
Cut-to-length/Shortwood	R	See Tree-length comment. Concentration of slash in rows by single grip harvesters will create an uneven distribution of aspen suckers.

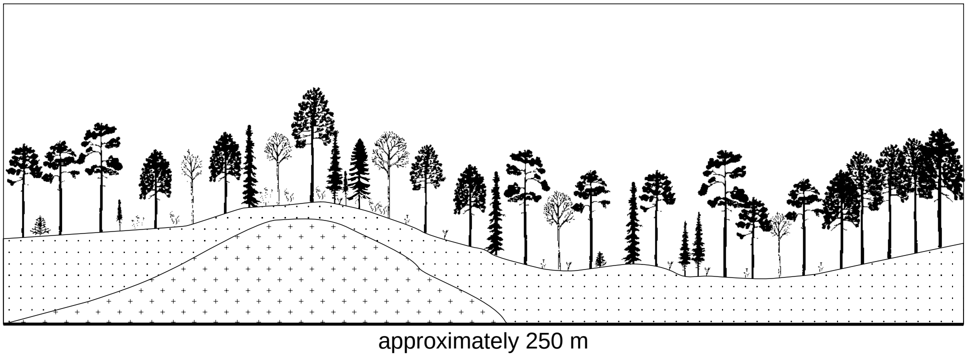
R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Aspen (con't)

Renewal Treatments	Comments	
Site Preparation • Mechanical	NR	
• Chemical	R	Chemical site preparation may be used on sites where the residual overstorey will negatively affect root suckering. 2,4-D is recommended since it will remove the overstorey without damaging the aspen root systems.
• Prescribed Burn	R	
Regeneration • Natural - Advance Growth	NR	Aspen does not regenerate under a closed canopy.
- Seed	NR	Aspen regeneration from seed is highly variable.
- Vegetative (coppice)	R	
• Artificial - Planting	NR	Insufficient data and/or field experience exist to recommend this technique. Planting of aspen seedlings may be considered when existing aspen has deteriorated to a point where vegetative regeneration is unlikely or undesirable.
- Seeding	NR	Insufficient data and/or field experience exist to recommend this technique.
- Scarification	R	
Tending Treatments		
Cleaning		Moderate to high competition on this site. High initial densities and rapid early growth of aspen suckers will ensure their successful renewal.
• Manual	NR	
• Mechanical	NR	
• Chemical - Ground	NR	
- Aerial	NR	
Spacing	R	Site quality and timing is critical for the success of this treatment.

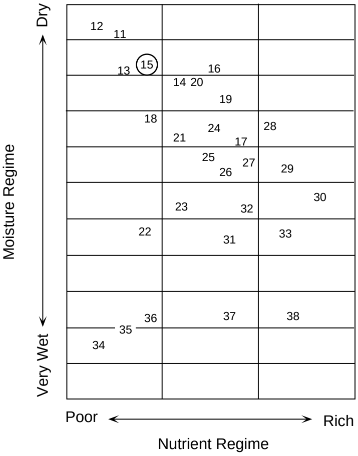
R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Red Pine–White Pine: Sandy Soil ES 15



General Description

Conifer dominated or mixed stands with red and white pine and white birch. Balsam fir and black spruce occur occasionally throughout. White cedar may be locally common. Generally shrub- and herb-poor; richness increases as canopy becomes more open. Soils dry to moderately fresh, rapidly to well drained, coarse to fine sandy. Predominantly on glaciofluvial and morainal parent materials. Ground cover consists of conifer and broadleaf litter and feathermoss.



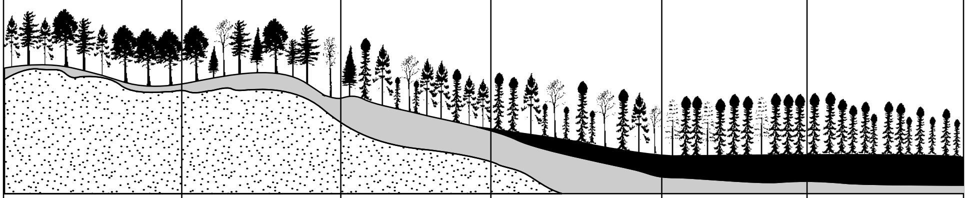
Soil Types S2, S1, SS5
Mode of Deposition glaciofluvial, morainal
Humus Form fibrimor, humifibrimor
Overstorey red pine, white pine, balsam fir, white birch, black spruce
Shrubs/Trees (<10 m) *Acer spicatum, Corylus cornuta, Diervilla lonicera, Lonicera canadensis, balsam fir, white spruce, white birch, Linnaea borealis, Chimaphila umbellata, Vaccinium myrtilloides, Vaccinium angustifolium, Juniperus communis*
Herbs and Graminoids *Aster macrophyllus, Streptopus roseus, Aralia nudicaulis, Clintonia borealis, Trientalis borealis, Maianthemum canadense, Cornus canadensis, Lycopodium obscurum, Lycopodium clavatum*
Mosses and Lichens *Pleurozium schreberi, Ptilium crista-castrensis, Hylocomium splendens*

Comments

Primarily composed of characteristic V-types V12, V13, V26 and V27. Expect a wide variety of associated vegetation including white cedar, especially in southwest portion of region (Site Regions 4S, 5W and 5S). Topography varied. Grades to ES16 as the proportion of red and white pine decreases, or to ES18 as soils grade toward coarse loamy.

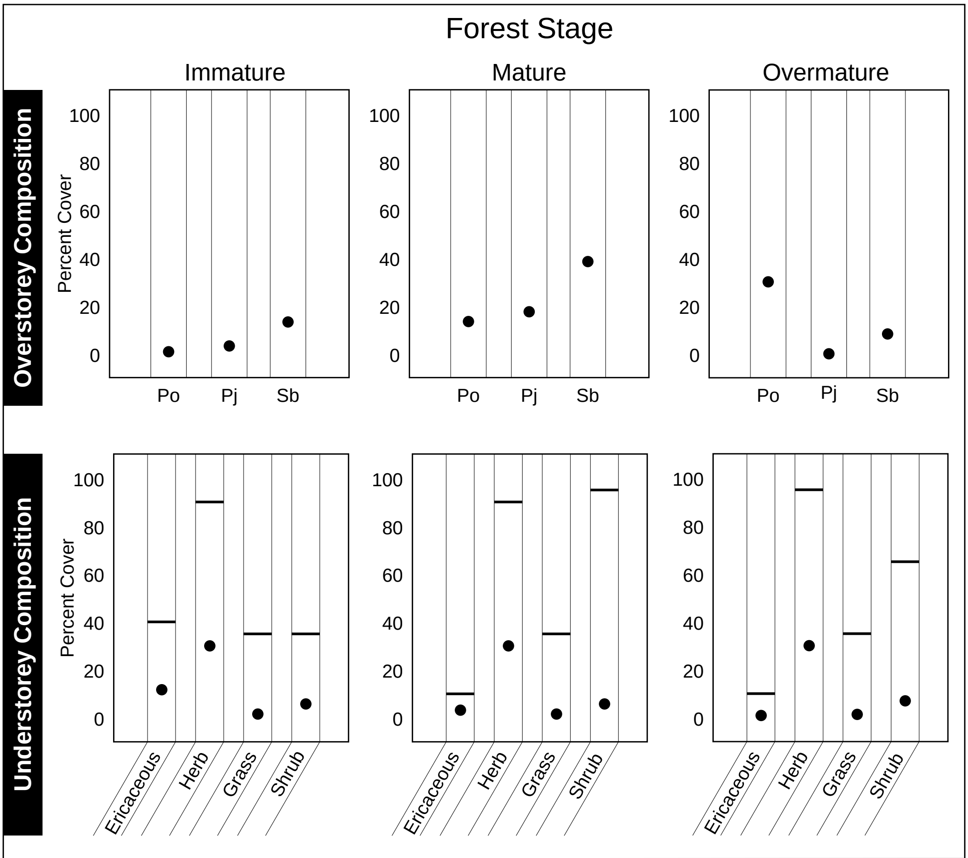
Typical Landscape Associations

Typical Ecosite Sequence on Very Shallow to Deep Coarse Loamy Till Material



Pr-Pw (Pj)	Pw-Pr-Bw (Po)	Pj-Sb (Bf-Bw)	Sb-Bw (Pj)	Sb (Ta)	Sb
ES11 Red Pine-White Pine-Jack Pine: Very Shallow Soil	ES18 Red Pine-White PIne: Fresh, Coarse Loamy Soil	ES20 Spruce-Pine/Feathermoss: Fresh, Sandy-Coarse Loamy Soil	ES22 Spruce-Pine/Ledum/Feathermoss: Moist, Sandy-Coarse Loamy Soil	ES35 Poor Swamp: Black Spruce: Organic Soil	ES34 Treed Bog: Black Spruce/Sphagnum: Organic Soil
V12 White PIne Mixedwood	V13 Red PIne Mixedwood	V18 Jack Pine Mixedwood/Feathermoss	V20 Black Spruce Mixedwood/Feathermoss	V34 Black Spruce/Labrador-tea/Feathermoss (Sphagnum)	V38 Black Spruce/Leatherleaf/Sphagnum
SS3 Very Shallow Soil On Bedrock	SS6 Shallow-Moderately Deep/Coarse Loamy	S3 Fresh/Coarse Loamy	S8 Moist/Coarse Loamy	S12F Wet/Organic (Feathermoss)	S12S Wet/Organic (Sphagnum)
Dry	Dry-Fresh	Fresh	Moist	Wet	Wet

Site Structure and Composition



Advance Growth	Forest Stage					
	Immature		Mature		Overmature	
	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)
Sb	865	N/A	898	N/A	813	N/A
Bf	678	N/A	975	N/A	542	N/A

Seedbed															
	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen
	0	18	0	81	1	0	18	3	78	1	0	18	0	81	1

Coarse Woody Debris						
	Logs	Debris	Logs	Debris	Logs	Debris
	N/A	N/A	N/A	N/A	N/A	N/A

Vegetation and Soil Type Relationships

(number of plots with defined combinations)

Description of Soil and Vegetation

- ▨ Characteristic Common
- ■ Common Inclusions
- □ Characteristic Uncommon

White Pine Mixedwood 12	Red Pine Mixedwood 13	White Pine Conifer 26	Red Pine Conifer 27		
▨	▨	□	□		
3	14	5	15	▨	S1 – Dry / Coarse Sandy
4	3	2	5	▨	S2 – Fresh / Fine Sandy
	2		1	■	SS5 – Shallow – Moderately Deep / Sandy

Selected Species Habitat Use

Species	Forest Stage					Special Habitat Preferences
	Pre-sapling	Sapling	Immature	Mature	Overmature	
Spruce Grouse			○	○	○	
Great Grey Owl						
Black-backed Woodpecker				●	●	snags
Pileated Woodpecker						
Least Flycatcher						
Boreal Chickadee				○	○	snags
Swainson's Thrush			○	○	○	
Nashville Warbler		○	○	○		high level of light penetration, preferably with shallow undergrowth
Connecticut Warbler						
White-throated Sparrow	○	○			○	numerous openings with low dense vegetation
Northern Flying Squirrel				○	○	snags
Southern Red-backed Vole		○	○	○	○	downed woody debris
Meadow Vole						
Marten			○	●	●	snags, downed woody debris
Woodland Caribou (winter)						
Woodland Caribou (hab. rank)						
White-tailed Deer (forage)						
White-tailed Deer (cover)						
Moose (forage)	○	○				
Moose (cover)			○	○	○	

○ Used Habitat ● Preferred Habitat

Successional Relationships - Natural

This ecosite is characterized by a homogeneous main canopy dominated by red pine or white pine. Balsam fir, black spruce, white birch and aspen occur as scattered individuals throughout the main canopy although they are shorter-lived. Jack pine is less frequently encountered on this ecosite. Canopy closure is relatively high in younger stand with older stands exhibiting a more open canopy structure associated with loss of individual trees. Stand ages commonly range from 40 to 240 years with the majority falling in the 55 to 115 year range.

White birch and black spruce are common elements in the upper sub-canopy of ES15 although their occurrence and percent cover remains low. White birch, black spruce and white pine are also common constituents of the lower sub-canopy at older ages. Balsam fir and white birch are the most frequent species in the sapling layer but rarely enters the tall shrub or sub-canopy layers. Red pine saplings occur approximately one-third of the time where individual tree gaps and windthrow have occurred creating suitable exposed microsites in the understorey. Under these situations it is not uncommon to also find aspen vegetative reproduction.

Succession is towards a more open two-tiered canopy dominated by red and/or white pine. Black spruce, balsam fir, trembling and large-toothed aspen decline in cover as age of the stand increases. Black spruce density and cover increases through time, but is generally restricted to the lower and upper sub-canopies of older stands.

Cover by shrubs such as green alder, serviceberry, prickly wild rose and *Diervilla lonicera* in most stands is low. Tall shrubs such as beaked hazel and mountain maple may be locally abundant on fresh to very fresh moisture regimes associated with fine-textured aeolian caps of silty very fine sand to silt loams or in mid- to lower-slope positions. Under these situations it is not uncommon to have beaked hazel and mountain maple occurring with moderate cover throughout the understorey.

Tall and low shrub cover within the stand declines further through time, while the occurrence of ericaceous shrubs such as *Vaccinium* spp. and *Arctostaphylos uva-ursa* (bear berry) increases. Total herb cover is initially low and continues to decline through time. Forest floor cover by *Pleorozium schreberi* increases with time reflecting changes in understorey micro-environment and changes in LFH composition and litter chemistry. In contrast, the presence and mean percent cover of pioneer lichens such as *Cladina* spp. declines through time. Species richness, diversity and eveness show little change over time.

The successional dynamics of these ecosites is dependent upon substrate conditions, fire frequency and intensity and physiography. Although red pine and white pine cones are not serotinous, fire is critical to their regeneration. Low intensity surface fires during the life of the stand will have two main effects: reduction of woody shrub competition, and exposure of a mineral soil seedbed. Continued recruitment of red and white pine into ES15 is greatest in stands where low intensity surface fires occurred every 20 to 40 years, and where the interval between catastrophic crown fires is >100 years. Such conditions generally occur in specific physiographic settings such as exposed ridges and on steep slopes and islands in large lakes. More intense surface fires on dry sites kill a proportion of mature trees creating gaps in the main canopy and promoting regeneration of red and white pine and white birch.

Long-term succession (>250 years) will be directed either towards a more open canopy black spruce - ericaceous shrub - feathermoss condition or white pine - feathermoss - *Cladina* spp. in the absence of fires or towards a self-perpetuating red pine dominated stand. Stand recruitment of white pine is facilitated by local disturbances such as surface fires, windthrow and natural mortality of mature individuals. Regional physiography and landform features are important factors determining successional trajectories in old-growth red and white pine forests.

Successional Relationships - Post-harvest

Response following harvest:

Varying soil conditions on ‘moderately deep to deep’ sites result in different responses depending on the forest stand conditions present at time of harvest. The presence of a viable red or white pine seed source from residual standards or adjacent stands will contribute to the perpetuation of those species on this ecosite. An aspen component present in the original canopy is likely to be maintained through vegetative suckering while white birch gradually disappears in the stand with time.

Stocking of black spruce and balsam fir in the sub-canopy or as advance growth in the understorey will be greatly reduced following canopy removal due to exposure, sunscald and increased droughtiness of the site. However, substantial numbers of all-aged balsam fir seedlings are likely to survive in the low shrub layer.

Response following harvest and mechanical site preparation:

Disturbance and mixing of the LFH with mineral soil will create suitable seedbed for red, white and black spruce. If black spruce is present in the original stand, its presence in the future stand may be enhanced by scarification on the site.

Response following harvest and prescribed fire:

Following harvesting and prescribed fire, the growth of grasses such as *Oryzopsis* spp., ericaceous shrubs (blueberry) and herbs (fireweed) is stimulated. These species will quickly dominate the site within two years. Low intensity surface fires will be effective in reducing future competition from woody shrubs and exposing a mineral soil seedbed suitable for conifer establishment. Prescribed fire will destroy any black spruce or balsam fir advance growth and will usually girdle any seedling red and white pine. Moderate to severe intensity surface fires will completely remove the surface organic horizons and kill any hardwood shrubs or aspen present on the cutover although seedbed conditions for species which reproduce using windborne seeds (i.e. grasses, sedges, fireweed) will be enhanced.

The application of understorey prescribed fire prior to harvesting can provide an opportunity to create favorable micro-site conditions for red and white pine and reduce the abundance and vigor of non-crop vegetation. Factors affecting the success of this technique in northwestern Ontario include the initial density and crown coverage of the overstorey, the degree to which the tree canopy has become stratified creating potential fuel laddering, timing relative to cone production and seed release, the density and cover of flammable species such as white birch and balsam fir in the sub-canopy and tall shrub layers, and whether it is logistically and financially possible to conduct more than one understorey prescribed burn prior to harvesting.

Site Productivity

Site Index by species and NWO FEC Soil Type

Site Index (breast height age 50 years)

Soil Type	Species		
	Sb	Pj	Po
S1	13.0	18.3	19.3
S2	11.9	16.9	20.1
SS5	10.8	16.2	16.9

Black Spruce Advance Regeneration

	Vegetation Type			
	V12	V13	V26	V27
Stocking (%)	N/A	N/A	N/A	N/A
Stocking Range	N/A	N/A	N/A	N/A
Stems per ha	N/A	N/A	N/A	N/A

V12 and V13 are the characteristic vegetation types. V26 and V27 are common inclusions on this ecosite.

Red pine-white pine dominated vegetation types V12, V13, V26 and V27 were not surveyed for advance growth. Due to the low density of black spruce in these V-types, black spruce advance growth is assumed to be low.

Natural Ingress Probability and Density (ten years post-disturbance)

No information available

Critical Comments

- Balsam fir, red maple, beaked hazel, green alder and mountain maple are low to moderate in abundance and well distributed throughout a relatively open understorey when the canopy is dominated by V13 (Red Pine Mixedwood) and V27 (Red Pine Conifer).
- An abundance of balsam fir, mountain maple and beaked hazel is usually found when the canopy is dominated by V12 (White Pine Mixedwood) and V26 (White Pine Conifer).
- Older stands with a significant understorey canopy of balsam fir are highly vulnerable to defoliation by the eastern spruce budworm creating potential wildfire hazards and impediments to harvesting and silviculture operations.
- *Armillaria* spp. infestations may develop on sites with significant trembling aspen content (V12, V13).
- White pine blister rust *(Cronartium ribicola*) is endemic and may affect white pine on the site.
- Stands containing high proportions of jack pine growing on extremely shallow soils may be vulnerable to jack pine budworm infestations.
- Exposed mineral soil seedbeds will be prone to seasonal drought and dessication. Mineral soil seedbeds associated with V12 and V13 persists for only a very short period of time.

Site Characteristics, Limitations and Hazard Potential

Characteristics							Limitations				Hazard Potential				
LFH Layer	Soil Texture	Depth to Bedrock	Stoniness	Moisture Regime	Terrain	Competition	Windthrow	Frost Heaving	Drought/Desiccation	Seasonal Flooding	Compaction	Rutting	Soil Erosion	Biomass & Nutrient Removal	Silvicultural Activities
1	3	5											5	1	Harvesting
1,2	3	5		4			5		4,5				5	1	Renewal
	3	5											5		Tending

Footnotes:

1. Harvesting and renewal activities must limit biomass and nutrient removal.
2. LFH layer is a poor seedbed.
3. Coarse textured soils are nutrient poor.
4. Dry moisture regime prone to seasonal drought/desiccation.
5. Shallow soils (20 to 50 cm) susceptible to erosion, seasonal drought/desiccation, windthrow and low nutrient levels.

Opportunities

- This ecosite may be successfully managed for red pine or white pine, under the selection or shelterwood systems. Pre-harvest understorey prescribed fire will control competing vegetation, create receptive seedbed, and reduce the cedar and balsam fir component. Light intensity mechanical site preparation to expose mineral soil will also create suitable seedbed.
- This ecosite is ideal for maintaining red and white pine through an ‘extended rotation’ posssessing old growth characteristics. No treatment will eventually result in the dominance of later successional species at the expense of the pines, and significantly increase wildfire hazard potential.
- After harvest, these sites can only be converted to black spruce or jack pine dominated conditions through planting. Low to moderate competition levels, coupled with reasonable growth rates make this a cost-effective treatment. Planting without site preparation, where site conditions permit, will moderate both moisture and temperature extremes and minimize competition.

Silvicultural Intensity Considerations

Species Objective	Site Productivity	Degree of Effort to Reach Free-to-grow
Black spruce	2 – 3	3
Jack pine	2	1
Aspen	3	N/A

Site Productivity - Site Productivity class (prime land productivity class) based upon height of dominant trees at age 50 years (breast height).

Degree of Effort

1 = Extensive
2 = Basic
3 = Intensive
4 = Highly Intensive

Silvicultural Interpretations for the Establishment of Black Spruce

Silvicultural System **• Harvest Method**		**Comments**
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	R	Residual stand will not contribute seed of sufficient quantity. However, this cutting technique may be prescribed to meet other management objectives.
- Patch	R	See Strip/Block comment
- Seed-tree	NR	Potential for natural seeding is very low due to infrequent occurrence of black spruce in the original stand. Potential for seasonal drought will further limit the success of this treatment.
Shelterwood	NR	Black spruce is mid-tolerant and susceptible to windthrow after thinning of closed canopy stands.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	CR	Full tree harvesting is conditionally recommended provided that "best practices" are used to minimize disturbance of the surface organic layer. Where surface organic thickness averages < 5 cm, winter harvest and/or use of high flotation equipment should be considered to maintain the integrity of the surface organic layer.
Tree-length	R	Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	R	See Tree-length comment.
Renewal Treatments		
Site Preparation		Low competition on this site.
• Mechanical	CR	Apply techniques that maintain a high percentage of intact forest floor to limit the risk of nutrient loss.
• Chemical	R	Some herbicide-resistant non-crop vegetation may occur on this site.
• Prescribed Burn	CR	Prescribed fire is conditionally recommended due to potential loss of organic matter and nutrients. Low to moderate severity fire which removes ≤ 50% of the surface organic layer is permissible and will result in the creation of suitable seedbed/plantable spots.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Black Spruce (con't)

Renewal Treatments	Comments	
Regeneration • Natural - Advance Growth	NR	Insufficient data exist. Site conditions imply low levels of black spruce advance growth.
- Seed	NR	Insufficient data exist. Site conditions imply low levels of black spruce ingress.
- Vegetative (coppice)	NR	Black spruce does not coppice.
• Artificial - Planting	R	
- Seeding	NR	Seeding success is reduced on sandy soils. A dry moisture regime and smothering of seedbeds with hardwood litter will further limit success.
- Scarification	NR	Cone supply is very low due to low density of black spruce in the original stand.
Tending Treatments		
Cleaning		Low competition on this site and cleaning is not usually required.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing is usually not necessary since black spruce natural regeneration is minimal.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine

Silvicultural System **• Harvest Method**	**Comments**	
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	R	Residual stand will not contribute seed of sufficient quantity or genetic quality. However, this cutting technique may be prescribed to meet other management objectives.
- Patch	R	See Strip/Block comment.
- Seed-tree	NR	Potential for natural seeding is very low due to infrequent occurrence of jack pine in the original stand.
Shelterwood	NR	Jack pine is shade-intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	CR	Full tree harvesting is conditionally recommended provided that "best practices" are used to minimize disturbance of the surface organic layer. Where surface organic thickness averages < 5 cm, winter harvest and/or use of high flotation equipment should be considered to maintain the integrity of the surface organic layer.
Tree-length	R	Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	R	See Tree-length comment.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine (con't)

Renewal Treatments	Comments	
Site Preparation		Low competition on this site.
• Mechanical	CR	Apply techniques that maintain a high percentage of intact forest floor to limit the loss of nutrients.
• Chemical	R	Herbicide selection must be carefully considered when regeneration by seed is prescribed. Herbicides may negatively impact seeding success. Some herbicide-resistant non-crop species may occur on this site.
• Prescribed Burn	CR	Prescribed fire is conditionally recommended due to potential loss of organic matter and nutrients. Low to moderate severity fire which removes ≤ 50% of the surface organic layer is permissible and will result in the creation of suitable seedbed/plantable spots.
Regeneration • Natural - Advance Growth	NR	Jack pine does not regenerate under a closed canopy.
- Seed	NR	Potential for natural seeding is very low due to infrequent occurrence of jack pine in the original stand.
- Vegetative (coppice)	NR	Jack pine does not coppice.
• Artificial - Planting	R	
- Seeding	R	Good distribution of mineral soil seedbeds will contribute to success. This site is prone to seasonal drought which will influence the success of this treatment
- Scarification	NR	Cone supply is very low due to low density of jack pine in the original stand. Regeneration levels associated with cone scattering will be highly variable.
Tending Treatments		
Cleaning		Low competition on this site and cleaning is not usually required.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing will be beneficial where jack pine density is high from natural or direct seeding.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Aspen

Silvicultural System **• Harvest Method**		**Comments**
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	CR	Strips should be at least 20 m wide to warm the soil and stimulate suckering. Strip cutting can also be prescribed to meet other management objectives.
- Patch	CR	Openings 0.4 ha in size are the minimum acceptable to stimulate aspen suckering. Patch cutting can also be prescribed to meet other management objectives.
- Seed-tree	NR	Leaving live aspen will reduce suckering.
Shelterwood	NR	Aspen is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	CR	Full tree harvesting is conditionally recommended provided that "best practices" are used to minimize disturbance of the surface organic layer. Where surface organic thickness averages < 5 cm, winter harvest and/or use of high flotation equipment should be considered to maintain the integrity of the surface organic layer.
Tree-length	R	Slash remaining on the site will reduce soil temperature and sucker production.
Cut-to-length/Shortwood	R	See Tree-length comment. Concentration of slash in rows by single grip harvesters will create an uneven distribution of aspen suckers.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

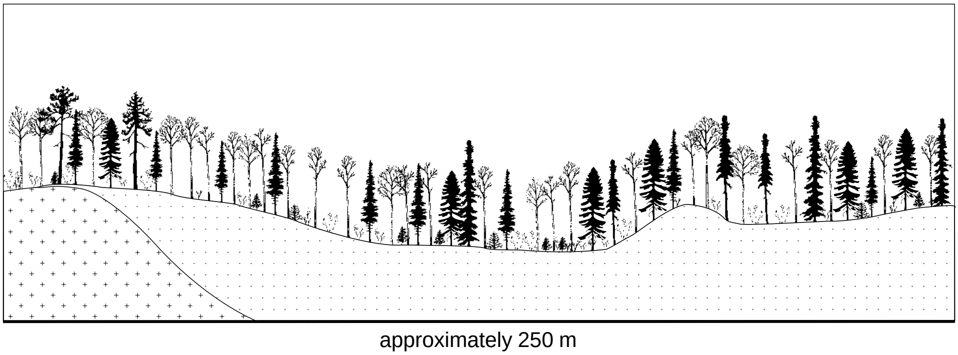
Silvicultural Interpretations for the Establishment of Aspen (con't)

Renewal Treatments	Comments	
Site Preparation • Mechanical	NR	See Scarification (Section II, Book I).
• Chemical	R	Chemical site preparation may be used on sites where the residual overstorey will negatively affect root suckering. 2,4-D is recommended since it will remove the overstorey without damaging the aspen root systems.
• Prescribed Burn	R	
Regeneration • Natural - Advance Growth	NR	Aspen does not regenerate under a closed canopy.
- Seed	NR	Aspen regeneration from seed is highly variable.
- Vegetative (coppice)	R	
• Artificial - Planting	NR	Insufficient data and/or field experience exist to recommend this technique. Planting of aspen seedlings may be considered when existing aspen has deteriorated to a point where vegetative regeneration is unlikely or undesirable.
- Seeding	NR	Insufficient data and/or field experience exist to recommend this technique.
- Scarification	R	
Tending Treatments		Generally low competition on this site. High initial densities and rapid early growth of aspen suckers will ensure their successful renewal.
Cleaning		
• Manual	NR	
• Mechanical	NR	
• Chemical - Ground	NR	
- Aerial	NR	
Spacing	R	Site quality and timing is critical for the success of this treatment.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

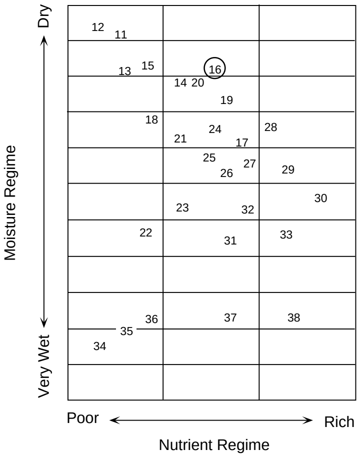
Hardwood–Fir–Spruce Mixedwood: Sandy Soil

ES 16



General Description

Dominated by trembling aspen, white birch, balsam fir with occasional white spruce, black spruce and jack pine. The deciduous component exceeds 50% of the canopy. Typically shrub- and herb-rich. Typically on deep soil sites, soils are dry to moderately fresh, rapidly to well drained, coarse to fine sandy. Parent materials commonly glaciofluvial on deep soil sites and morainal on moderately deep sites. Ground cover consists of broadleaf litter, conifer litter and wood.



Soil Types
S2, SS5, S1

Mode of Deposition
glaciofluvial, morainal

Humus Form
fibrimor, humifibrimor

Overstorey
trembling aspen, balsam fir, white birch, white spruce, black spruce, jack pine

Shrubs/Trees (<10 m)
Acer spicatum, Corylus cornuta, Diervilla lonicera, Lonicera canadensis, Linnaea borealis, balsam fir, white spruce, Sorbus decora, trembling aspen

Herbs and Graminoids
Aster macrophyllus, Mitella nuda, Streptopus roseus, Viola renifolia, Aralia nudicaulis, Galium triflorum, Clintonia borealis, Trientalis borealis, Maianthemum canadense, Cornus canadensis, Actaea rubra, Lycopodium spp.

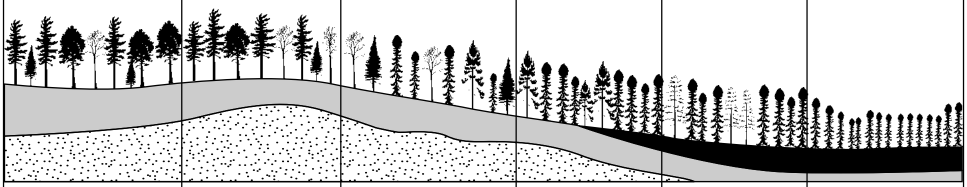
Mosses and Lichens
Pleurozium schreberi, Ptilium crista-castrensis, Hylocomium splendens, Rhytidiadelphus triquetrus

Comments

Conditions range from relatively pure trembling aspen or white birch to a wide range of hardwood dominated mixedwoods. Conifer overstory composition is typically quite variable, hence the range of V-types occurring within this ecosite. Characteristic V-types include V4, V5, V6, V7, V8, V9, V10 and V11. Expect to see V17, V18 and V20 in patches throughout the ecosite.

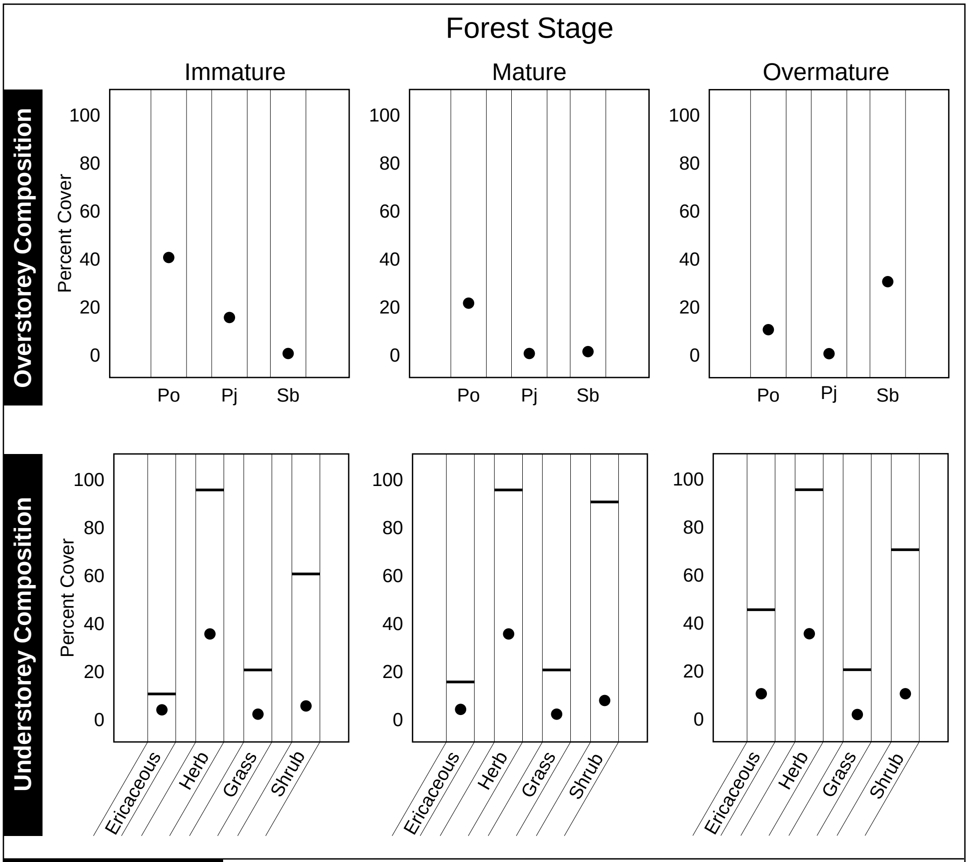
Typical Landscape Associations

Typical Ecosite Sequence on Sandy Glaciofluvial Soil Material



Pr-Pw	Pr-Pw-Pw	Sb-Bw-Pj (Bf)	Sb (Pj)	Sb -Ta	Stunted Sb
ES15 Red Pine-White Pine: Sandy Soil	ES15 Red Pine-White Pine: Sandy Soil	ES14 Pine-Spruce Mixedwood: Sandy Soil	ES22 Spruce-Pine/ Ledum/ Feathermoss: Moist, Sandy-Coarse Loamy Soil	ES36 Intermediate Swamp: Black Spruce (Tamarack): Organic Soil	ES34 Treed Bog: Black Spruce/ Sphagnum: Organic Soil
V27 Red Pine Conifer	V12 White Pine Mixedwood	V18 Jack Pine Mixedwood/ Feathermoss	V33 Black Spruce/ Feathermoss	V23 Tamarack (Bllack Spruce)/ Speckled Alder/ Labrador-tea	V38 Black Spruce/ Leatherleaf/ Sphagnum
S1 Dry/ Coarse Sandy	S2 Fresh/ Fine Sandy	S2 Fresh/ Fine Sandy	S7 Moist/Sandy	S12F Wet/Organic (Feathermoss)	S12S Wet/Organic (Sphagnum)
Dry	Dry	Moderately Fresh	Moist	Wet	Wet

Site Structure and Composition



Advance Growth	Forest Stage					
	Immature		Mature		Overmature	
	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)
Sb	0	N/A	1050	N/A	234	N/A
Bf	0	N/A	459	N/A	125	N/A

Seedbed															
	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen
	0	11	84	n/a	5	0	11	84	n/a	5	0	11	84	n/a	5

Coarse Woody Debris						
	Logs	Debris	Logs	Debris	Logs	Debris
	N/A	N/A	N/A	N/A	N/A	N/A

Vegetation and Soil Type Relationships

(number of plots with defined combinations)

4 White Birch Hardwood and Mixedwood	5 Aspen Hardwood	6 Trembling Aspen (White Birch) – Balsam Fir – Mountain Maple	7 Trembling Aspen – Balsam Fir / Balsam Fir Shrub	8 Trembling Aspen (White Birch) / Mountain Maple	9 Trembling Aspen Mixedwood	10 Trembling Aspen – Black Spruce – Jack Pine / Low Shrub	11 Trembling Aspen – Conifer / Blueberry / Feathermoss		
						▨	▨		
7	8	5	3	8	2	12	9	▨	S1 – Dry / Coarse Sandy
9	10	9	6	5	5	8	6	▨	S2 – Fresh / Fine Sandy
2	3	1		1	1	4	3	■	SS5 – Shallow – Moderately Deep / Sandy

Description of Soil and Vegetation
- ▨ Characteristic Common
- ■ Common Inclusions
- ☐ Characteristic Uncommon

Selected Species Habitat Use

	Forest Stage					
Species	Pre-sapling	Sapling	Immature	Mature	Overmature	Special Habitat Preferences
Spruce Grouse			○	○	○	
Great Grey Owl						
Black-backed Woodpecker						
Pileated Woodpecker				○	●	snags, downed woody debris
Least Flycatcher				○	○	often found near open spaces (edge, riparian)
Boreal Chickadee				○	○	snags
Swainson's Thrush			●	●	●	
Nashville Warbler		○	○	○		high level of light penetration, preferably with shallow undergrowth
Connecticut Warbler						
White-throated Sparrow	○	○			○	numerous openings with low dense vegetation
Northern Flying Squirrel				○	○	snags
Southern Red-backed Vole		○	○	○	○	downed woody debris
Meadow Vole						
Marten			○	○	○	snags, downed woody debris
Woodland Caribou (winter)						
Woodland Caribou (hab. rank)			○	○	○	
White-tailed Deer (forage)	○	○			○	
White-tailed Deer (cover)						
Moose (forage)	○	○	○	○	○	
Moose (cover)			○	○	○	

○ Used Habitat ● Preferred Habitat

Successional Relationships - Natural

These stands are often dominated by trembling aspen or white birch in the canopy. Pure upper canopies of either hardwood are possible, but white spruce, balsam fir, black spruce and/or the other hardwood are occasional codominants. Total tree cover remains high during much of this stands existence. When aspen dominates in the canopy, balsam fir, white spruce and white birch are commonly encountered in the sub-canopy. The tall and low shrub layers are usually dominated by balsam fir although white birch and black spruce can also occur. In contrast, when white birch dominates the main canopy, jack pine is often a significant component of the main canopy — especially on shallow (<2 m depth) and rapidly-drained sandy soils. Stand age varies from 40 to 167 years with the majority of sites occurring in the 40 to 100 year range.

The tall and low shrub layers beneath an aspen dominated stand are often dominated by *Corylus cornuta* and *Acer spicatum*; *Diervilla lonicera* is present in the low shrub layer at high cover. *Acer spicatum* is replaced by *Alnus crispa* in stands dominated by white birch. Tall shrubs are frequent and occur at moderate cover in most stands. The herb layer is floristically rich and herb cover is high. *Aster macrophyllus* and *Aralia nudicaulis* are the most abundant herbs.

In the absence of the spruce budworm, the overall successional trajectory for these stands is toward a more open, multi-tiered and uneven-aged canopy of mixed species composition. Canopy cover increases up to age 100 years and then begins to decline as the intolerant hardwoods begin to ‘fall out’ of the canopy. The hardwood component is slowly replaced by coniferous species, particularly, white and black spruce and balsam fir. The oldest stands are uneven-aged and show strong conifer regeneration in the sub-canopy and seedling layers. Residual aspen stems from the original stand may persist for 200 years or more on moist sites while on dry sites they usually succumb to disease. White birch persists in the sub-canopy of some stands — the result of light, surface fires beneath the main canopy.

Black spruce may be favored by gap creation created through stand breakup of the white birch dominated mixedwoods. Likewise, balsam fir is favored by gap creation in trembling aspen dominated mixedwoods. At even older ages (140 years) and in the absence of fire, sparse regeneration of the hardwood components results in an increasing dominance by woody shrubs and shade tolerant conifers such as balsam fir. The balsam fir sub-canopy component in aspen dominated stands eventually grows through into the main canopy; in contrast, it is black spruce which dominates in the older birch mixed woods. Species richness, diversity and evenness increase marginally over time. Mean tree species richness, diversity and evenness all increase over time, indicating the increasingly ‘mixed’ nature of the canopy-sub-canopy as stands age.

The cover of tall shrubs and *Diervilla lonicera* generally declines with increasing age whereas *Vaccinium* spp. increases in abundance and distribution. Suckering by trembling aspen is common, but these individuals seldom enter the sub-canopy. Herb cover declines after 100 years reflecting the increase in canopy cover by conifers and the associated change in light conditions and the geochemistry of the forest floor.

Successional Relationships - Post-harvest

Response following harvest:

Post-harvest successional patterns are extremely complex to predict due to the combined interaction of soil/site conditions, original stand conditions, season of harvest and severity and duration of the harvest activity. Following harvest, aspen and white birch increase in density and dominance due to rapid sprouting and suckering. Removal of the overstorey results in the reproduction and growth of wood shrubs and the herbaceous layer. The protection of conifer advance growth often will result in stand development patterns and compositions similar to that following wildfire; however, the prevalent species in the post-logging cover type is balsam fir due to lack of a spruce seed source and a sufficient quantity and quality of receptive seedbed for white and black spruce. Careful logging techniques will result in a mixedwood stand condition where balsam fir is a significant component.

Response following harvest and mechanical site preparation:

Following harvest, aspen and white birch increase in density and dominance due to rapid sprouting and suckering. Removal of the overstorey results in the reproduction and growth of wood shrubs and the herbaceous layer. Mechanical site preparation stimulates hardwood suckering and sprouting of shrubs — especially *Corylus cornuta*. The cover by herbs also increases. However, mechanical site preparation on these sites is very effective in reducing the proportion of balsam fir in the new stand arising from advance growth present at time of harvest. Post-harvest advance regeneration of balsam fir which survives following mechanical site preparation is generally of poor quality. Overall, mechanical site preparation will create a successional shift to favor hardwoods.

Response following harvest and prescribed fire:

High intensity severe prescribed burns will effectively reduce the density and dominance of aspen and white birch in the regeneration phase. Prescribed fire is successful in eliminating balsam fir regeneration and advance growth; the degree of impact is related to severity and intensity of the burn.

Site Productivity

Site Index by species and NWO FEC Soil Type

Site Index (breast height age 50 years)

Soil Type	Species		
	Sb	Pj	Po
S1	13.0	18.3	19.3
S2	11.9	16.9	20.1
SS5	10.8	16.2	16.9

Black Spruce Advance Regeneration

	Vegetation Type						
	V4	V5	V6	V7	V8	V10	V11
Stocking (%)	6	3	N/A	N/A	3	8	17
Stocking Range	0 – 35	0 – 20	N/A	N/A	0 – 6	0 – 25	0 – 75
Stems per ha	3900	200	N/A	N/A	100	700	1200

V10 and V11 are the characteristic vegetation types with others occurring only in local patches.

This ecosite is dominated by trembling aspen, white birch and balsam fir with some white spruce, black spruce and jack pine.

This ecosite has a low probability of sufficient number and distribution of black spruce advance growth to regenerate the site.

The number and distribution of black spruce advance growth on this ecosite is positively related to:

- basal area of black spruce in the original stand

and inversely related to:

- percent cover of herbaceous species
- percent cover of broadleaf litter
- percent canopy closure.

Natural Ingress Probability and Density (ten years post-disturbance)

No information available

Critical Comments

- Woody shrub and hardwood tree competition from aspen, mountain maple, green alder, beaked hazel and balsam fir on V5, V6, V7, V8, V9, V10, V11, V17, and V18. White birch will be a significant component of any portion of this ecosite dominated by V4; aspen a significant component on all other sites.
- Most tree species will be highly susceptible to *Armillaria* spp. on this site Balsam fir, white spruce and black spruce may also be susceptible to *Inonotus tomentosus* on the same sites where *Armillaria* spp. occurs.
- Stands are vulnerable to spruce budworm if the proportion of balsam fir and white spruce in the stands exceeds 20 percent of the total crown volume.
- Soil/site conditions limit the use of hexazinone products for chemical site preparation.
- Natural regeneration of black spruce and jack pine limited by available local seed supply and lack of suitable receptive seedbed which will persist for several years.

Site Characteristics, Limitations and Hazard Potential

Characteristics								Limitations					Hazard Potential		
LFH Layer	Soil Texture	Depth to Bedrock	Stoniness	Moisture Regime	Terrain	Competition	Windthrow	Frost Heaving	Drought/Desiccation	Seasonal Flooding	Compaction	Rutting	Soil Erosion	Biomass & Nutrient Removal	Silvicultural Activities
1	3												5	1	Harvesting
1,2	3			4		6	5		4,5				5	1	Renewal
	3					6							5		Tending

Footnotes:

1. Harvesting and renewal activities must limit biomass and nutrient removal.
2. LFH layer is a poor seedbed.
3. Coarse textured soils are nutrient poor.
4. Dry moisture regime prone to seasonal drought/desiccation.
5. Shallow soils (20 to 50 cm) susceptible to erosion, seasonal drought/desiccation, windthrow and low nutrient levels.
6. Moderate to high competition with mountain maple, beaked hazel, balsam fir and aspen as the principle competitors.

Opportunities

- This ecosite can be managed to support forests dominated by balsam fir, white birch, and/or white spruce.
- Black spruce, white spruce, or jack pine must be planted in order to ensure successful regeneration to these species.
- Prescribed fire can reduce balsam fir advance growth, control the early onset of competitive vegetation, and create plantable spots on deep, dry to fresh, fine sands.
- Option exists to selectively harvest and underplant white spruce or to enhance the conifer component on the site by planting black and/or white spruce in a patch shelterwood situation.
- Browse production potential is high, both before and after harvest.
- Value for marten and fisher will increase with age, conifer composition, number of snags and structural diversity.

Silvicultural Intensity Considerations

Species Objective	Site Productivity	Degree of Effort to Reach Free-to-grow
Black spruce	2 – 3	3
Jack pine	2	1 – 2
Aspen	3	1

Degree of Effort

1 = Extensive
2 = Basic
3 = Intensive
4 = Highly Intensive

Site Productivity - Site Productivity class (prime land productivity class) based upon height of dominant trees at age 50 years (breast height).

Silvicultural Interpretations for the Establishment of Black Spruce

Silvicultural System **• Harvest Method**		**Comments**
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	R	Residual stand will not contribute seed of sufficient quantity. However, this cutting technique may be prescribed to meet other management objectives.
- Patch	R	See Strip/Block comment.
- Seed-tree	NR	Potential for natural seeding is very low due to infrequent occurrence of black spruce in the original stand. Potential for seasonal drought will further limit the success of this treatment.
Shelterwood	NR	Black spruce is mid-tolerant to shade and susceptible to windthrow after thinning of closed canopy stands.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	CR	Full tree harvesting is conditionally recommended provided that "best practices" are used to minimize disturbance and/or displacement of the surface organic layer.
Tree-length	R	Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	R	See Tree-length comment.
Renewal Treatments		
Site Preparation		Moderate to high competition on this site.
• Mechanical	CR	Apply techniques that maintain a high percentage of intact forest floor to limit the risk of nutrient loss. Chemi-mechanical site preparation should be considered. Potential for standing dead and down woody debris resulting from repeat spruce budworm infestation is high and will affect equipment operability and effectiveness.
• Chemical	R	Some herbicide-resistant non-crop species may occur on this site.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Black Spruce (con't)

Renewal Treatments	Comments	
• Prescribed Burn	CR	Prescribed fire is conditionally recommended due to potential loss of organic matter and nutrients. Low to moderate severity fire which removes ≤ 50% of the surface organic layer is permissible and will result in the creation of suitable seedbed/plantable spots.
Regeneration • Natural - Advance Growth	NR	Black spruce advance growth is not of sufficient quantity or distribution to regenerate the site.
- Seed	NR	Insufficient data exist. Site conditions imply low levels of black spruce ingress.
- Vegetative (coppice)	NR	Black spruce does not coppice.
• Artificial - Planting	R	
- Seeding	NR	On sandy soils, seeding success is reduced. A dry moisture regime and smothering of seedbeds with hardwood litter will further limit success.
- Scarification	NR	Cone supply is very low due to the low density of black spruce in the original stand.
Tending Treatments		
Cleaning		Moderate to high competition on this site.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing is usually not necessary since black spruce natural regeneration is minimal.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine

Silvicultural System **• Harvest Method**		**Comments**
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	R	Residual stand will not contribute seed of sufficient quantity or genetic quality. However, this cutting technique may be prescribed to meet other management objectives.
- Patch	R	See Strip/Block comment.
- Seed-tree	NR	Potential for natural seeding is very low due to infrequent occurrence of jack pine in the original stand.
Shelterwood	NR	Jack pine is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	CR	Full tree harvesting is conditionally recommended provided that "best practices" are used to minimize disturbance and/or displacement of the surface organic layer.
Tree-length	R	Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	R	See Tree-length comment.
Renewal Treatments		
Site Preparation		Moderate to high competition on this site.
• Mechanical	CR	Apply techniques that maintain a high percentage of intact forest floor to limit the risk of nutrient loss. Chemi-mechanical site preparation should be considered. Potential for standing dead and down woody debris resulting from repeat spruce budworm infestation is high and will affect equipment operability and effectiveness.
• Chemical	R	Some herbicide-resistant non-crop species may occur on this site.
• Prescribed Burn	CR	Prescribed fire is conditionally recommended due to potential loss of organic matter and nutrients. Low to moderate severity fire which removes $\leq$ 50% of the surface organic layer is permissible and will result in the creation of suitable seedbed/plantable spots.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine (con't)

Renewal Treatments	Comments	
Regeneration • Natural - Advance Growth	NR	Jack pine does not regenerate under a closed canopy.
- Seed	NR	Potential for natural seeding is very low due to infrequent occurrence of jack pine in the original stand.
- Vegetative (coppice)	NR	Jack pine does not coppice.
• Artificial - Planting	R	
- Seeding	CR	Shelter seeding only. Good selection of seedbed micro-sites will contribute to success. This site is prone to seasonal drought which will influence the success of this treatment. Smothering of seedbeds with hardwood litter will further limit broadcast seeding success. Competitive non-crop vegetation will affect the survival and growth of bare seed jack pine.
- Scarification	NR	Cone supply is very low due to low density of jack pine in the original stand. Regeneration levels associated with cone scattering will be highly variable.
Tending Treatments		
Cleaning		Moderate to high competition on this site.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant competitors may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing will be beneficial when density is high from natural or direct seeding.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Aspen

Silvicultural System **• Harvest Method**	**Comments**	
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	CR	Strips should be at least 20 m wide to warm the soil and stimulate suckering. Strip cutting can also be prescribed to meet other management objectives.
- Patch	CR	Openings 0.4 ha in size are the minimum acceptable to stimulate aspen suckering. Patch cutting can also be prescribed to meet other management objectives.
- Seed-tree	NR	Leaving live aspen will reduce suckering.
Shelterwood	NR	Aspen is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	CR	Full tree harvesting is conditionally recommended provided that "best practices" are used to minimize disturbance and/or displacement of the surface organic layer.
Tree-length	R	Slash remaining on the site will reduce soil temperature and sucker production.
Cut-to-length/Shortwood	R	See Tree-length comment. Concentration of slash in rows by single grip harvesters will create an uneven distribution of aspen suckers.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

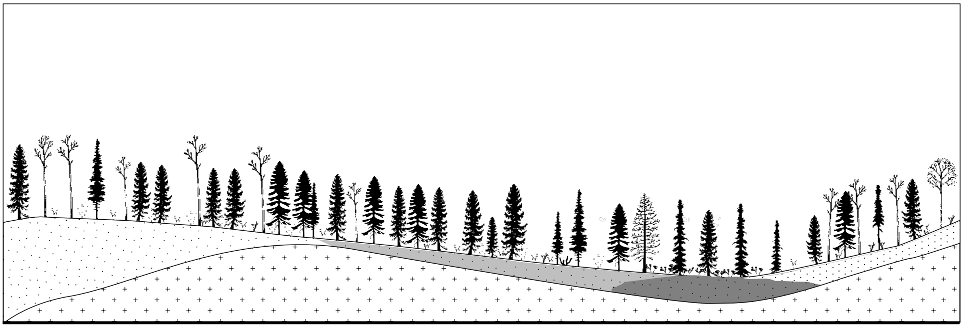
Silvicultural Interpretations for the Establishment of Aspen (con't)

Renewal Treatments	Comments	
Site Preparation • Mechanical	NR	See Scarification (Section II, Book I).
• Chemical	R	Chemical site preparation may be used on sites where the residual overstorey will negatively affect root suckering. 2,4-D is recommended since it will remove the overstorey without damaging the aspen root systems.
• Prescribed Burn	R	
Regeneration • Natural - Advance Growth	NR	Aspen does not regenerate under a closed canopy.
- Seed	NR	Aspen regeneration from seed is highly variable.
-Vegetative (coppice)	R	
• Artificial - Planting	NR	Insufficient data and/or field experience exist to recommend this technique. Planting of aspen seedlings may be considered when existing aspen has deteriorated to a point where vegetative regeneration is unlikely or undesirable.
- Seeding	NR	Insufficient data and/or field experience exist to recommend this technique.
- Scarification	R	
Tending Treatments		Moderate to high competition on this site. High initial densities and rapid early growth of aspen suckers will ensure their successful renewal.
Cleaning		
• Manual	NR	
• Mechanical	NR	
• Chemical - Ground	NR	
- Aerial	NR	
Spacing	R	Site quality and timing is critical for the success of this treatment.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

White Cedar: Fresh–Moist, Coarse–Fine Loamy Soil

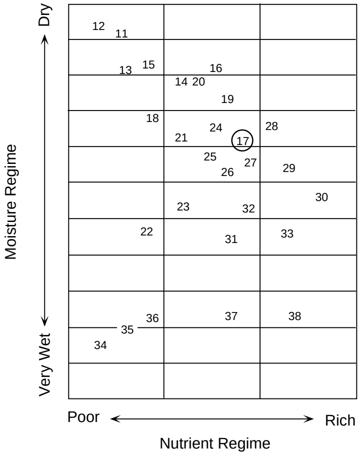
ES 17



approximately 250 m

General Description

Diverse ecosite consisting of cedar dominated conifer and mixedwood stands. Shrub layer variable, usually dominated by Acer spicatum, balsam fir and white cedar. Shrubs dense where concentration of hardwood is high, or canopy thins. Occurs across a wide range of landforms and soil conditions. Ground cover consists of conifer litter, broadleaf litter, feathermoss and wood.



Soil Types
S3, S4, S6, SS7, S9, S10

Mode of Deposition
morainal, lacustrine, fluvial

Humus Form
humifibrimor, fibrihumimor

Overstorey
white cedar, balsam fir, white birch, white spruce, trembling aspen

Shrubs/Trees (<10 m)
balsam fir, *Acer spicatum, white cedar, Rubus pubescens, Linnaea borealis, Sorbus decora, Lonicera canadensis, Ribes triste, Corylus cornuta*

Herbs and Graminoids
Trientalis borealis, Viola renifolia, Mitella nuda, Aralia nudicaulis, Maianthemum canadense, Clintonia borealis, Cornus canadensis, Streptopus roseus, Galium triflorum, Aster macrophyllus, Gymnocarpium dryopteris

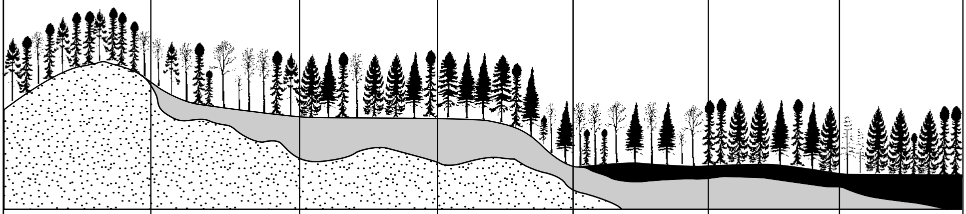
Mosses and Lichens
Pleurozium schreberi, Rhytidiadelphus triquetrus, Hylocomium splendens, Ptilium crista-castrensis, Plagiomnium cuspidatum, Drepanocladus uncinatus

Comments

Ecosite is extremely variable and occurs on a wide variety of soil textures and moisture conditions. Usually associated with calcium-rich soils, especially on “Greenstone Belts.” V21 characteristic and dominant, but expect the vegetation cover to grade to V22 with increasing moisture. Expect occurrences of V1, V2, V23, V14 and V24. Microtopography ranges from flat to undulating but rarely hummocky, often with an extensive mat of conifer litter.

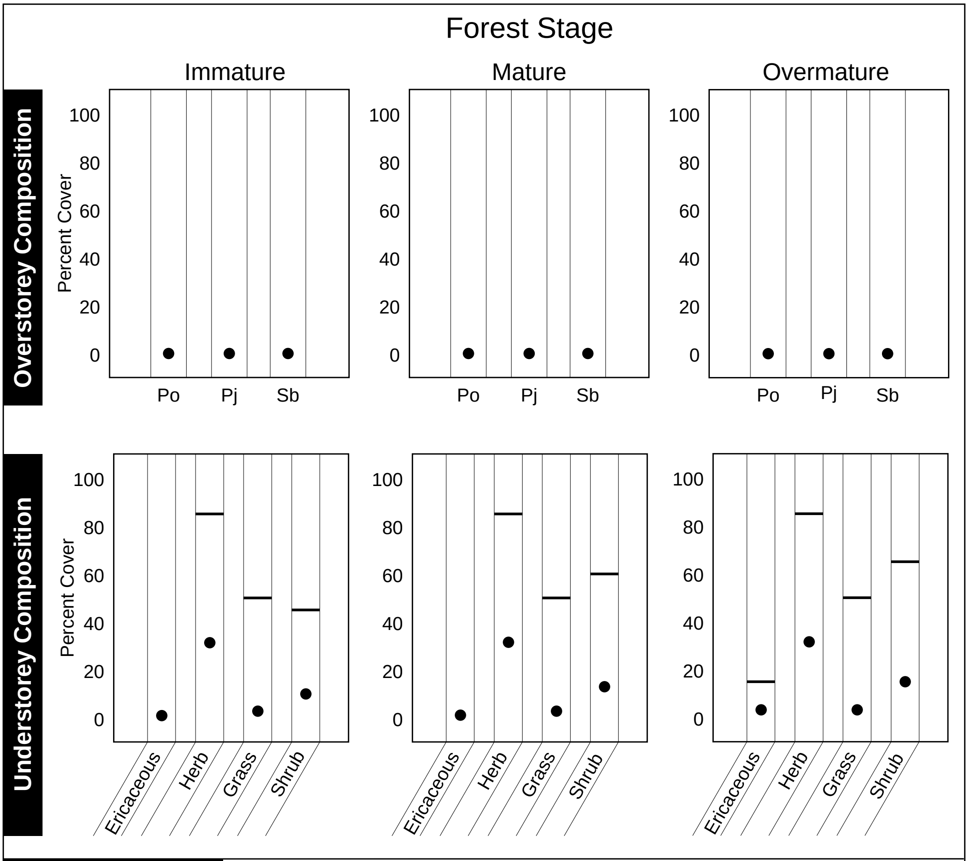
Typical Landscape Associations

Typical Ecosite Sequence on Very Shallow to Deep Coarse Loamy Till Material



Sb-Pj (Po)	Po-Sb-Pj (Bw)	Ce-Bf (Sb-Po)	Bf-Sw (Po-Sb)	Po-Bf-Bw (Sb)	Ce-Sb (Bf)	Ce-Sb (Ta)
ES12 Black Spruce-Jack Pine: Very Shallow Soil	ES19 Hardwood-Fir-Spruce Mixedwood: Fresh, Sandy-Coarse Loamy Soil	ES17 White Cedar: Fresh-Moist, Coarse-Fine Loamy Soil	ES21 Fir-Spruce Mixedwood: Fresh, Coarse Loamy Soil	ES23 Hardwood-Fir-Spruce Mixedwood: Moist, Sandy-Coarse Loamy Soil	ES17 White Cedar: Fresh-Moist, Coarse-Fine Loamy Soil	ES37 Rich Swamp: Cedar (Other conifer): Organic Soil
V30 Jack Pine-Black Spruce/ Blueberry/Lichen	V11 Trembling Aspen-Conifer/Blueberry/ Feathermoss	V21 Cedar (inc. Mixedwood)/ Mountain Maple	V16 Balsam Fir-White Spruce Mixedwood/ Feathermoss	V6 Trembling Aspen (White Birch)-Balsam Fir/ Mountain Maple	V21 Cedar (inc. Mixedwood)/ Mountain Maple	V22 Cedar (inc. Mixedwood)/ Speckled Alder/ Sphagnum
SS2 Exremely Shallow Soil on Bedrock	SS6 Shallow-Moderately Deep/ Coarse Loamy	S3 Fresh/ Coarse Loamy	S3 Fresh/ Coarse Loamy	S8 Moist/ Coarse Loamy	S8 Moist/ Coarse Loamy	S12S Wet/Organic (Sphagnum)
Dry	Dry-Fresh	Fresh	Fresh	Moist	Moist	Wet

Site Structure and Composition



Advance Growth

Forest Stage

	Immature		Mature		Overmature	
	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)
Sb	485	N/A	290	N/A	285	N/A
Bf	360	N/A	285	N/A	267	N/A

Seedbed

Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen
15	30	8	42	0	15	30	8	42	0	15	30	8	42	0

Coarse Woody Debris

Logs	Debris	Logs	Debris	Logs	Debris
N/A	N/A	N/A	N/A	N/A	N/A

Vegetation and Soil Type Relationships

(number of plots with defined combinations)

Cedar (inc. Mixedwood) / Mountain Maple			
21			
▒			
4	▒	S3 –	Fresh / Coarse Loamy
1	□	S4 –	Fresh / Silty – Silt Loamy
5	▒	SS7–	Shallow – Moderately Deep / Silty – Fine Loamy – Clayey
	□	S9 –	Moist/ Silty – Silt Loamy
3	□	S10 –	Moist / Fine Loamy – Clayey

Description of Soil and Vegetation

▒ Characteristic Common

■ Common Inclusions

□ Characteristic Uncommon

Selected Species Habitat Use

Species	Forest Stage: Pre-sapling	Sapling	Immature	Mature	Overmature	Special Habitat Preferences
Spruce Grouse						
Great Grey Owl						
Black-backed Woodpecker						
Pileated Woodpecker						
Least Flycatcher						
Boreal Chickadee				○	○	snags
Swainson's Thrush			○	○	○	
Nashville Warbler		○	○	○		high level of light penetration, preferably with shallow undergrowth
Connecticut Warbler						
White-throated Sparrow	○	○			○	numerous openings with low dense vegetation
Northern Flying Squirrel				○	○	snags
Southern Red-backed Vole		○	○	●	●	downed woody debris
Meadow Vole						
Marten			○	○	○	snags, downed woody debris
Woodland Caribou (winter)						
Woodland Caribou (hab. rank)				○	○	
White-tailed Deer (forage)	○	○				
White-tailed Deer (cover)			○	●	●	
Moose (forage)	○	○				
Moose (cover)			○	○	○	

○ Used Habitat ● Preferred Habitat

Successional Relationships - Natural

No information available

Successional Relationships - Post-harvest

Response following harvest:

No information available

Response following harvest and mechanical site preparation:

No information available

Response following harvest and prescribed fire:

No information available

Site Productivity

Site Index by species and NWO FEC Soil Type

Site Index (breast height age 50 years)

Soil Type	Species		
	Sb	Pj	Po
S3	14.8	17.5	17.7
S4	13.8	21.2	21.4
SS7	13.7	14.2	22.2
S9	15.4	18.0	21.8
S10	10.0	17.0	22.8

Black Spruce Advance Regeneration

	Vegetation Type	
	V21	V22
Stocking (%)	N/A	21
Stocking Range	N/A	0 – 60
Stems per ha	N/A	1600

V21 and V22 are the characteristic vegetation types on this ecosite.

White cedar dominates the ecosite with balsam fir, white birch, white spruce, and trembling aspen present in varying proportions.

This ecosite has a low probability of sufficient number and distribution of black spruce advance growth to regenerate the site.

The number and distribution of black spruce advance growth on this ecosite is positively related to:

- basal area of black spruce in the original stand

and inversely related to:

- percent cover of herbaceous species
- percent cover of broadleaf litter
- percent canopy closure

Natural Ingress Probability and Density (ten years post-disturbance)

No information available

Critical Comments

- Moderate to high levels of competition can be expected from aspen, green alder, mountain maple, beaked hazel, red maple, white birch, balsam fir and *Calamagrostis candensis.*
- Most tree species will be highly susceptible to *Armillaria* spp. on this site. Potential for stand decadence and large volumes of residual, non-merchantable material may limit operability in this ecosite.
- Stands are vulnerable to spruce budworm if the proportion of balsam fir and white spruce in the stands exceeds 20 percent of the total crown volume. Risk increases with stand age, proportion of balsam fir and proximity to infested stands.
- Natural regeneration heavily dominated by balsam fir.
- Extensive slash resulting from, dead and dying balsam fir, residual balsam fir and balsam fir advance growth will limit the effectiveness of intermittent patch scarifiers and passive disc-trenchers.

Site Characteristics, Limitations and Hazard Potential

Characteristics							Limitations				Hazard Potential				
LFH Layer	Soil Texture	Depth to Bedrock	Stoniness	Moisture Regime	Terrain	Competition	Windthrow	Frost Heaving	Drought/Desiccation	Seasonal Flooding	Compaction	Rutting	Soil Erosion	Biomass & Nutrient Removal	Silvicultural Activities
1	1,3		4	3	5						3	3	1,5		Harvesting
1,2	1,3		4	3	5	1,6	7	1			3	3	1,5		Renewal
	1,3					1,6									Tending

Footnotes:

1. Disturbance of the forest floor on fine textured soils will promote competition from non-crop vegetation, and increase the potential for erosion and frost heaving.
2. LFH layer is a poor seedbed.
3. Fine textured soils are susceptible to compaction and rutting when saturated during the frost free period.
4. Potential for high surface stone content may limit equipment operability.
5. Soil erosion hazard increases with silt content. Hazard is moderate to high on slopes greater than ten percent.
6. High competition with mountain maple, beaked hazel, balsam fir and raspberry as the principle competitors.
7. Potential for windthrow of shallow rooted species on fine textured soils.

Opportunities

- This ecosite can be managed to support forests dominated by cedar, balsam fir, white birch, white pine and white spruce.
- Prescribed fire can reduce residual cedar and balsam fir if densities high after harvest.
- Ingress of naturals and advance growth potential low for most conifer species, therefore planting with subsequent competition control most effective.
- Potential high value to moose for browse production and winter habitat.
- Potential habitat for a variety of small mammals, furbearers and songbirds due to this ecosite's capacity to support stands of high structural and compositional diversity.

Silvicultural Intensity Considerations

Species Objective	Site Productivity	Degree of Effort to Reach Free-to-grow
Black spruce	1	3
Jack pine	1	3
Aspen	1	1

Site Productivity - Site Productivity class (prime land productivity class) based upon height of dominant trees at age 50 years (breast height).

Degree of Effort

1 = Extensive
2 = Basic
3 = Intensive
4 = Highly Intensive

Silvicultural Interpretations for the Establishment of Black Spruce

Silvicultural System **• Harvest Method**		**Comments**
Clearcut		Tree species diversity on these sites may result in a potentially high number of residual stems dependent upon market conditions. Non-commercial species and advance growth of balsam fir, cedar and balsam poplar may present harvesting concerns.
• Harvest Method - Conventional	R	
- Strip/Block	R	Residual stand will not contribute seed of sufficient quantity. However, this cutting technique may be prescribed to meet other management objectives.
- Patch	R	See Strip/Block comment.
- Seed-tree	NR	Potential for natural seeding is very low due to infrequent occurrence of black spruce in the original stand.
Shelterwood	NR	Black spruce is mid-tolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season.
Full-tree	R	
Tree-length	R	Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	R	See Tree-length comment.
Renewal Treatments		
Site Preparation		High competition on this site.
• Mechanical	R	Techniques, timing and sequencing of treatments should be carefully considered. Minimize mineral soil exposure on clays to reduce the incidence of soil baking and/or frost heaving, and to prevent an increase in non-crop vegetation associated with mixed mineral/organic microsite. Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season. Chemi-mechanical site preparation should be considered. Potential for standing dead and down woody debris resulting from repeat spruce budworm infestation is high and will affect equipment operability and effectiveness.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Black Spruce (con't)

Renewal Treatments	Comments	
• Chemical	R	Some herbicide-resistant non-crop species may occur on this site.
• Prescribed Burn	R	Severity of burn will affect vegetation response. Fire will be beneficial for reduction of balsam fir competition, standing dead and down woody debris and associated heavy slash loads.
Regeneration		
• Natural		
- Advance Growth	NR	Black spruce advance growth is not of sufficient quantity or distribution to form a significant part of the new stand.
- Seed	NR	Potential for natural seeding is very low due to infrequent occurrence of black spruce in the original stand.
- Vegetative (coppice)	NR	Black spruce does not coppice.
• Artificial		
- Planting	R	Plant close to the mineral/organic interface.
- Seeding	NR	The distribution, abundance and vigour of non-crop vegetation precludes the survival and growth of seed origin black spruce.
- Scarification	NR	Cone supply is very low due to the low density of black spruce in the original stand.
Tending Treatments		
Cleaning		High competition on this site.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing is usually not necessary since black spruce natural regeneration is minimal.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine

Silvicultural System • Harvest Method		Comments
Clearcut		Tree species diversity on these sites may result in a potentially high number of residual stems dependent upon market conditions. Non-commercial species and advance growth of balsam fir, cedar and balsam poplar may present harvesting concerns.
• Harvest Method - Conventional	R	
- Strip/Block	R	Residual stand will not contribute seed of sufficient quantity or genetic quality. However, this cutting technique may be prescribed to meet other management objectives.
- Patch	R	See Strip/Block comment.
- Seed-tree	NR	Potential for natural seeding is very low due to low occurrence of jack pine in the original stand.
Shelterwood	NR	Jack pine is shade-intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season.
Full-tree	R	
Tree-length	R	Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	R	See Tree-length comment.
Renewal Treatments		
Site Preparation		High competition on this site.
• Mechanical	R	Techniques, timing and sequencing of treatments should be carefully considered. Minimize mineral soil exposure on clays to reduce the incidence of soil baking and/or frost heaving, and to prevent increased competition from non-crop vegetation on a mixed mineral/organic microsite. Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season. Chemi-mechanical site preparation should be considered. Potential for standing dead and down woody debris resulting from repeat spruce budworm infestation is high and will affect equipment operability and effectiveness.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine (con't)

Renewal Treatments	**Comments**	
• Chemical	R	Some herbicide-resistant non-crop species may occur on this site.
• Prescribed Burn	R	Severity of burn will affect vegetation response. Fire will be beneficial in reducing balsam fir competition, standing dead and down woody debris and associated heavy slash loads.
Regeneration • Natural - Advance Growth	NR	Jack pine does not regenerate under a closed canopy.
- Seed	NR	Potential for natural seeding is very low due to infrequent occurrence of jack pine in the original stand.
- Vegetative (coppice)	NR	Jack pine does not coppice.
• Artificial - Planting	R	Plant close to the mineral/organic interface.
- Seeding	NR	Smothering of seedbeds with hardwood litter will limit success. In addition, the distribution, abundance and vigour of non-crop species precludes the survival and growth of seed origin jack pine.
- Scarification	NR	Cone supply is very low due to the low density of jack pine in the original stand. Regeneration levels associated with cone scattering will be highly variable.
Tending Treatments		
Cleaning		High competition on this site.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing is usually not necessary since jack pine natural regeneration is minimal.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Aspen

Silvicultural System **• Harvest Method**		**Comments**
Clearcut		Tree species diversity on these sites may result in a potentially high number of residual stems, dependent upon market conditions. Non-commercial species and advance growth of balsam fir, cedar and balsam poplar may present harvesting concerns.
• Harvest Method - Conventional	R	
- Strip/Block	R	Strips should be at least 20 m wide to warm the soil and stimulate suckering. Strip cutting can also be prescribed to meet other management objectives.
- Patch	R	Openings 0.4 ha in size are the minimum acceptable to stimulate aspen suckering. Patch cutting can also be prescribed to meet other management objectives.
- Seed-tree	NR	Leaving live aspen will reduce suckering.
Shelterwood	NR	Aspen is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	R	Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season.
Tree-length	R	See Full-tree comment. Slash remaining on the site will reduce soil temperature and sucker production.
Cut-to-length/Shortwood	R	See Tree-length comment. Concentration of slash in rows by single grip harvesters will create an uneven distribution of aspen suckers.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

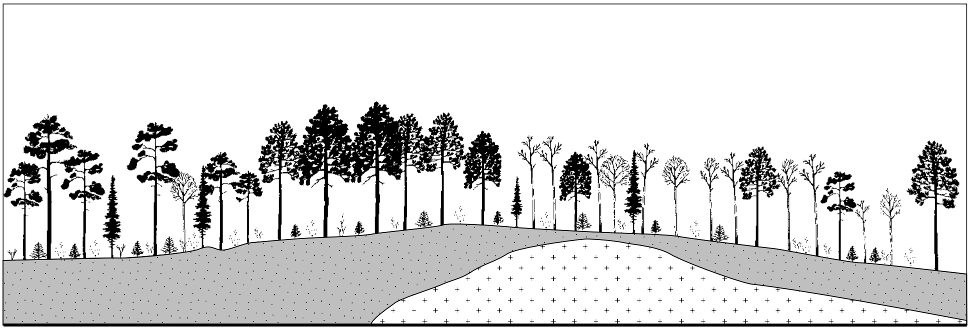
Silvicultural Interpretations for the Establishment of Aspen (con't)

Renewal Treatments	Comments	
Site Preparation • Mechanical	NR	See Scarification (Section II, Book I).
• Chemical	R	Chemical site preparation may be used on sites where the residual overstorey will negatively affect root suckering. 2,4-D is recommended since it will remove the overstorey without damaging the aspen root systems.
• Prescribed Burn	R	
Regeneration		Best growth of aspen occurs on these soils.
• Natural - Advance Growth	NR	Aspen does not regenerate under a closed canopy.
- Seed	NR	Aspen regeneration from seed is highly variable.
-Vegetative (coppice)	R	
• Artificial - Planting	NR	Insufficient data and/or field experience exist to recommend this technique. Planting of aspen seedlings may be considered when existing aspen has deteriorated to a point where vegetative regeneration is unlikely or undesirable.
- Seeding	NR	Insufficient data and/or field experience exist to recommend this technique.
- Scarification	R	
Tending Treatments		
Cleaning		High competition on this site. High initial densities and rapid early growth of aspen suckers will ensure their successful renewal.
• Manual	NR	
• Mechanical	NR	
• Chemical - Ground	NR	
- Aerial	NR	
Spacing	R	Site quality and timing is critical for the success of this treatment.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

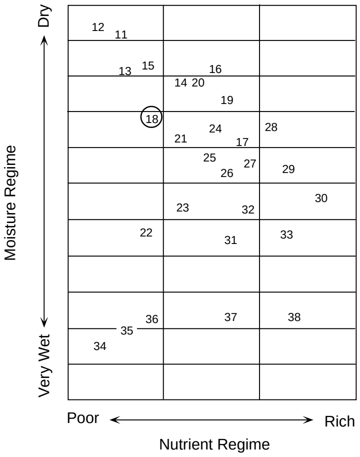
ES 18

Red Pine–White Pine: Fresh, Coarse Loamy Soil


approximately 250 m

General Description

Conifer dominated or mixed stands with red and white pine, occasionally with trembling aspen and/or white birch and balsam fir. Understory variable, from shrub- and herb-poor to rich. Soils are fresh, well drained, coarse loamy. Predominantly on morainal and glaciofluvial parent material. Ground cover consists of conifer litter, broadleaf litter, feathermoss and wood.



Soil Types
S3, SS6

Mode of Deposition
morainal, glaciofluvial

Humus Form
fibrimor, humifibrimor

Overstorey
red pine, white pine, white birch, trembling aspen, balsam fir

Shrubs/Trees (<10 m)
Acer spicatum, Corylus cornuta, Diervilla lonicera, balsam fir, white birch, *Linnaea borealis, Chimaphila umbellata*

Herbs and Graminoids
Aster macrophyllus, Aralia nudicalis, Streptopus roseus, Clintonia borealis, Trientalis borealis, Maianthemum canadense, Cornus canadensis

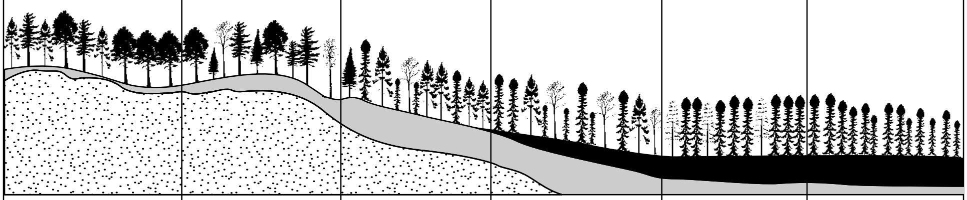
Mosses and Lichens
Pleurozium schreberi, Hylocomium splendens, Dicranum polysetum

Comments

Typically coniferous stands, sometimes with inclusions of mixedwoods. V-types V26, V27, and sometimes V12 and V13, are characteristic. Wide variety of other V-types may be expected.

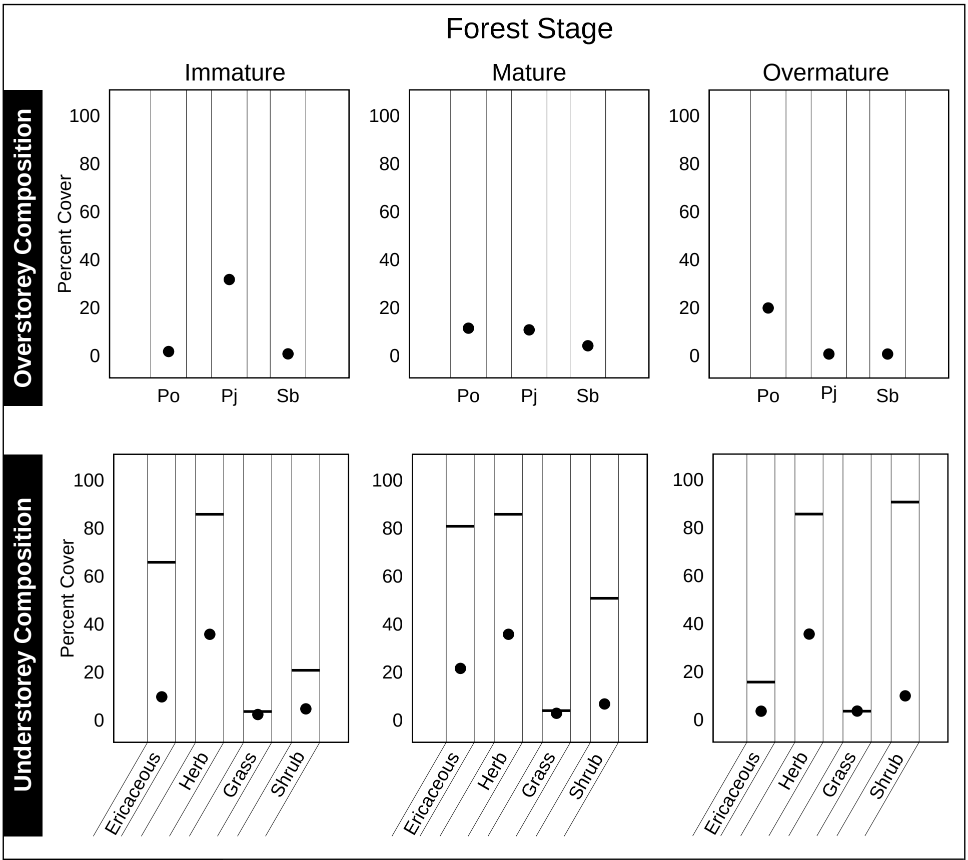
Typical Landscape Associations

Typical Ecosite Sequence on Very Shallow to Deep Coarse Loamy Till Material



Pr-Pw (Pj)	Pw-Pr-Bw (Po)	Pj-Sb (Bf-Bw)	Sb-Bw (Pj)	Sb (Ta)	Sb
ES11 Red Pine-White Pine-Jack Pine: Very Shallow Soil	ES18 Red Pine-White PIne: Fresh, Coarse Loamy Soil	ES20 Spruce-Pine/Feathermoss: Fresh, Sandy-Coarse Loamy Soil	ES22 Spruce-Pine/Ledum/Feathermoss: Moist, Sandy-Coarse Loamy Soil	ES35 Poor Swamp: Black Spruce: Organic Soil	ES34 Treed Bog: Black Spruce/Sphagnum: Organic Soil
V12 White PIne Mixedwood	V13 Red PIne Mixedwood	V18 Jack Pine Mixedwood/Feathermoss	V20 Black Spruce Mixedwood/Feathermoss	V34 Black Spruce/Labrador-tea/Feathermoss (Sphagnum)	V38 Black Spruce/Leatherleaf/Sphagnum
SS3 Very Shallow Soil On Bedrock	SS6 Shallow-Moderately Deep/Coarse Loamy	S3 Fresh/Coarse Loamy	S8 Moist/Coarse Loamy	S12F Wet/Organic (Feathermoss)	S12S Wet/Organic (Sphagnum)
Dry	Dry-Fresh	Fresh	Moist	Wet	Wet

Site Structure and Composition



Advance Growth

Forest Stage

	Immature		Mature		Overmature	
	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)
Sb	2500	N/A	781	N/A	1711	N/A
Bf	930	N/A	972	N/A	938	N/A

Seedbed

Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen
15	60	0	27	8	15	60	0	27	8	15	60	0	27	8

Coarse Woody Debris

Logs	Debris	Logs	Debris	Logs	Debris
N/A	N/A	N/A	N/A	N/A	N/A

Vegetation and Soil Type Relationships

(number of plots with defined combinations)

White Pine Mixedwood	Red Pine Mixedwood	White Pine Conifer	Red Pine Conifer		
12	13	26	27		
▨	▨	☐	☐		
9	5	2	10	▨	S3 – Fresh / Coarse Loamy
4	5	3	3	▨	SS6 – Shallow – Moderately Deep / Coarse Loamy

Description of Soil and Vegetation

- ▨ Characteristic Common
- ■ Common Inclusions
- ☐ Characteristic Uncommon

Selected Species Habitat Use

	Forest Stage					
Species	Pre-sapling	Sapling	Immature	Mature	Overmature	Special Habitat Preferences
Spruce Grouse						
Great Grey Owl						
Black-backed Woodpecker				○	○	snags
Pileated Woodpecker				○	●	snags, downed woody debris
Least Flycatcher						
Boreal Chickadee				○	○	snags
Swainson's Thrush			○	○	○	
Nashville Warbler		○	○	○		high level of light penetration, preferably with shallow undergrowth
Connecticut Warbler						
White-throated Sparrow	○	○			○	numerous openings with low dense vegetation
Northern Flying Squirrel				○	○	snags
Southern Red-backed Vole		○	○	●	●	downed woody debris
Meadow Vole						
Marten			○	○	○	snags, downed woody debris
Woodland Caribou (winter)						
Woodland Caribou (hab. rank)						
White-tailed Deer (forage)	○	○				
White-tailed Deer (cover)			○	●	●	
Moose (forage)	○	○				
Moose (cover)			○	○	○	

○ Used Habitat ● Preferred Habitat

Successional Relationships - Natural

This ecosite is characterized by a homogeneous main canopy dominated by red pine or white pine. Balsam fir, white birch and aspen occur as scattered individuals throughout the main canopy although they are shorter-lived. Canopy closure is relatively high in younger stands with older stands exhibiting a more open canopy structure associated with loss of individual trees. Stand ages commonly range from 60 to 135 years although those with a well-developed super-canopy of white pine may be as old as 275 years.

White birch and aspen are often found in the upper sub-canopy of ES18 although their occurrence and percent cover remains low. White birch, and white pine are also common constituents of the lower sub-canopy in older age stands. Balsam fir and white birch are the most frequent species in the sapling layer but rarely enters the tall shrub or sub-canopy layers.

Succession is towards a more open two-tiered canopy dominated by red and/or white pine but in comparison to ES11 and 15, the percent canopy cover of the overstorey pine in ES18 remains high. Older stands are characterized by a semi-closed canopy of white pine. Balsam fir density and cover increases through time, but is generally restricted to the lower and upper sub-canopies. The presence and abundance of eastern white cedar increase over time but it remains a relatively minor component of this ecosite. The resistance of individual white cedar trees to low to moderate intensity understorey fires is enhanced by their thick bark. This adaptation ensures their continued presence beneath a white pine super canopy. White birch remains a significant component in both the lower and upper canopies even at older ages - the result of one to several low to moderate severity surface fires creating favorable seedbeds and/or stimulating white birch basal sprouting.

The shrub layer is dominated by beaked hazel and mountain maple which occur at high frequency and moderate cover. Mountain maple is usually most abundant on fresh to very fresh moisture regimes associated with fine-textured aeolian caps of silty very fine sand to silt loams or in mid- to lower-slope positions. Beaked hazel also occurs under these moisture regimes but is often associated with sub-surface water movement and rapidly drained conditions created by increased stone content. Red maple may occur as a small component of the sub-canopy towards the Minnesota and Manitoba borders. The herb layer remains relatively rich throughout succession. Ground vegetation consisting of large-leaf aster, wild sarsaparilla and bush honeysuckle is common.

Tall and low shrub cover within the stand declines through time, while the occurrence of *Vaccinium* spp. and wild red raspberry increases as gaps develop in the main canopy. Total herb cover is initially low and continues to decline through time. Forest floor cover by *Pleurozium schreberi* and *Dicranum polysetum* increases with time reflecting changes in understorey micro-environment and changes in LFH composition and litter chemistry. Species richness, diversity and evenness are very similar in the younger and older stands. Tree and shrub diversity decline, while herb and cryptogram diversity increase.

The successional dynamics of these ecosites is dependent upon substrate conditions, fire frequency and intensity and physiography. Although red pine and white pine cones are not serotinous, fire is critical to their regeneration. Low intensity surface fires during the life of the stand will have two main effects: reduction of woody shrub competition and exposure of a mineral soil seedbed. Continued recruitment of red and white pine into ES18 is greatest in stands where low intensity surface fires occurred every 20 to 40 years, and where the interval between catastrophic crown fires is >100 years. More intense surface fires on dry sites kill a proportion of mature trees creating gaps in the main canopy and promoting regeneration of red and white pine and white birch.

Long-term succession (>250 years) will be directed either towards a super canopy of white pine with an understorey of white birch, balsam fir and the tall shrubs in the absence of fires or towards a self-perpetuating all-aged white pine dominated stand. Stand recruitment of white pine is facilitated by local disturbances such as surface fires, windthrow and natural mortality of mature individuals. Regional physiography and landform features are important factors determining successional trajectories in old-growth red and white pine forests.

Successional Relationships - Post-harvest

Response following harvest:

Varying soil conditions on 'moderately deep to deep' sites result in different responses depending on the forest stand conditions present at time of harvest. The presence of a viable red or white pine seed source from residual standards or adjacent stands will contribute to the perpetuation of those species on this ecosite. An aspen component present in the original canopy is likely to be maintained through vegetative suckering while the post-harvest densities of white birch will be low due to lack of a suitable supply and duration of receptive seedbed.

Stocking of black spruce and balsam fir in the sub-canopy or as advance growth in the understorey will be greatly reduced following canopy removal due to exposure, sunscald and increased droughtiness of the site. However, substantial numbers of all-aged balsam fir seedlings are likely to survive in the low shrub layer. Harvesting will release these seedlings and in the absence of fire or mechanical disturbance they will rapidly grow to occupy the site.

Response following harvest and mechanical site preparation:

Disturbance and mixing of the LFH with mineral soil will create suitable seedbed for red and white pine and black spruce. If black spruce is present in the original stand, its presence in the future stand may be enhanced by scarification on the site. Mechanical scarification will greatly reduce the density of residual balsam fir seedlings and saplings.

Response following harvest and prescribed fire:

Following prescribed fire and dependent upon fire intensity and severity, the growth of medium to wide-bladed grasses and herbaceous species is stimulated. These species will quickly dominate the site within two years. Medium to high severity surface fires will be effective in reducing future competition from woody shrubs and exposing a mineral soil seedbed suitable for conifer establishment. Prescribed fire will destroy any black spruce or balsam fir advance growth and will usually girdle any seedling red and white pine. Moderate to severe intensity surface fires will completely remove the surface organic horizons and kill any aspen present on the cutover.

Site Productivity

Site Index by species and NWO FEC Soil Type

Site Index (breast height age 50 years)

Soil Type	Species		
	Sb	Pj	Po
S3	14.8	17.5	17.7
SS6	13.6	16.7	17.9

Black Spruce Advance Regeneration

	Vegetation Type			
	V12	V13	V26	V27
Stocking (%)	N/A	N/A	N/A	N/A
Stocking Range	N/A	N/A	N/A	N/A
Stems per ha	N/A	N/A	N/A	N/A

V12 and V13 are the characteristic vegetation types. V26 and V27 are common inclusions on this ecosite.

Red pine-white pine dominated vegetation types V12, V13, V26 and V27 were not surveyed for black spruce advance growth. Due to the low density of black spruce in these V-types, black spruce advance growth is assumed to be low.

Natural Ingress Probability and Density (ten years post-disturbance)

No information available

Critical Comments

- Moderate to high levels of competition from mountain maple, beaked hazel and aspen (when the latter occurs in the stand).
- Extremely varied topography often creates deeper soil pockets which will support various amounts of trembling aspen and white birch. *Armillaria* spp. infestations may develop on sites with a significant aspen content V12, V13).
- White pine blister rust *(Cronartium ribicola*) is endemic and may affect white pine on the site.
- Shallow to moderately deep soils containing a high proportion of boulders and cobbles may limit mechanical site preparation.
- Exposed mineral soil seedbeds will be prone to seasonal drought and dessication. Mineral soil seedbeds associated with V12 and V13 persists for only a very short period of time.

Site Characteristics, Limitations and Hazard Potential

Characteristics							Limitations						Hazard Potential		
LFH Layer	Soil Texture	Depth to Bedrock	Stoniness	Moisture Regime	Terrain	Competition	Windthrow	Frost Heaving	Drought/Desiccation	Seasonal Flooding	Compaction	Rutting	Soil Erosion	Biomass & Nutrient Removal	Silvicultural Activities
	3	3	4										3		Harvesting
1	2	3	4			5	3		3				3		Renewal
	2	3				5									Tending

Footnotes:

1. LFH layer is a poor seedbed.
2. Coarse textured soils are nutrient poor.
3. Shallow soils (20 to 50 cm) susceptible to erosion, seasonal drought/desiccation, windthrow and low nutrient levels.
4. Potential for high surface stone content may limit equipment operability.
5. Moderate to high competition with mountain maple, beaked hazel and aspen as the principle competitors.

Opportunities

- Selection or shelterwood harvest to maintain red and white component is effective treatment. Pre-harvest understory prescribed fire will control competing vegetation, create receptive seedbed, and reduce the cedar and balsam fir component. Light mechanical site preparation to expose mineral soil will also create suitable seedbed.
- This ecosite is ideal for red and white pine old growth production. No treatment will eventually result in the dominance of later successional species at the expense of the pines, and significantly increase wildfire hazard potential.
- Ideal sites for planting red pine or white pine. Competition levels highly variable.
- After harvest, these sites can only be converted to black spruce or jack pine working groups through planting. Planting without site preparation, where site conditions permit, will moderate both moisture and temperature extremes and minimize competition.

Silvicultural Intensity Considerations

Species Objective	Site Productivity	Degree of Effort to Reach Free-to-grow
Black spruce	1 – 2	3
Jack pine	1 – 2	2
Aspen	1	1

Site Productivity - Site Productivity class (prime land productivity class) based upon height of dominant trees at age 50 years (breast height).

Degree of Effort

1 = Extensive
2 = Basic
3 = Intensive
4 = Highly Intensive

Silvicultural Interpretations for the Establishment of Black Spruce

Silvicultural System **• Harvest Method**		**Comments**
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	R	Residual stand will not contribute seed of sufficient quantity. However, this cutting technique may be prescribed to meet other management objectives.
- Patch	R	See Strip/Block comment.
- Seed-tree	NR	Potential for natural seeding is very low due to infrequent occurrence of black spruce in the original stand.
Shelterwood	NR	Black spruce is mid-tolerant and susceptible to windthrow after thinning of closed canopy stands.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	R	
Tree-length	R	Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	R	See Tree-length comment.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Black Spruce (con't)

Renewal Treatments	Comments	
Site Preparation		Moderate to high competition on this site.
• Mechanical	R	Techniques, timing and sequencing of treatments should be carefully considered to inhibit establishment of non-crop vegetation.
• Chemical	R	Some herbicide-resistant non-crop species may occur on this site.
• Prescribed Burn	R	Severity of burn will affect vegetation response. Fire will be beneficial for reduction of balsam fir competition, standing dead and down woody debris and associated heavy slash loads.
Regeneration		
• Natural		
- Advance Growth	NR	Insufficient data exist. Vegetation types imply low levels of black spruce advance growth.
- Seed	NR	Insufficient data exist. Infrequent occurrence of black spruce in the original stand precludes natural regeneration by seed.
- Vegetative (coppice)	NR	Black spruce does not coppice.
• Artificial		
- Planting	R	
- Seeding	CR	Shelter seeding only. Broadcast or spot seeding is not recommended. Proper microsite selection/preparation is critical to regeneration success. Competition must be controlled to ensure success of treatment.
- Scarification	NR	Cone supply is very low due to the low density of black spruce in the original stand.
Tending Treatments		
Cleaning		Moderate to high competition on this site.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing is usually not necessary since black spruce natural regeneration is minimal.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine

Silvicultural System • Harvest Method		Comments
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	R	Residual stand will not contribute seed of sufficient quantity or genetic quality. However, this cutting technique may be prescribed to meet other management objectives.
- Patch	R	See Strip/Block comment.
- Seed-tree	NR	Potential for natural seeding is very low due to infrequent occurrence of jack pine in the original stand.
Shelterwood	NR	Jack pine is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	R	
Tree-length	R	Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	R	See Tree-length comment.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine (con't)

Renewal Treatments		Comments
Site Preparation		Moderate to high competition on this site.
• Mechanical	R	Techniques, timing and sequencing of treatments should be carefully considered to inhibit establishment of non-crop vegetation.
• Chemical	R	Some herbicide-resistant non-crop species may occur on this site.
• Prescribed Burn	R	Severity of burn will affect vegetation response. Fire will be beneficial in reducing balsam fir competition, standing dead and down woody debris and associated heavy slash loads.
Regeneration • Natural - Advance Growth	NR	Jack pine does not regenerate under a closed canopy.
- Seed	NR	Insufficient data exist. Infrequent occurrence of jack pine in the original stand precludes natural regeneration by seed.
- Vegetative (coppice)	NR	Jack pine does not coppice.
• Artificial - Planting	R	
- Seeding	R	Good distribution of mineral soil seedbeds will contribute to success.
- Scarification	NR	Insufficient data exist. Cone supply is very low due to the low density of jack pine in the original stand. Regeneration levels associated with cone scattering will be highly variable.
Tending Treatments		
Cleaning		Moderate to high competition on this site.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species. Late summer cutting recommended.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing is usually not necessary since jack pine natural regeneration is minimal.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Aspen

Silvicultural System **• Harvest Method**		**Comments**
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	CR	Strips should be at least 20 m wide to warm the soil and stimulate suckering. Strip cutting can also be prescribed to meet other management objectives.
- Patch	CR	Openings 0.4 ha in size are the minimum acceptable to stimulate aspen suckering. Patch cutting can also be prescribed to meet other management objectives.
- Seed-tree	NR	Leaving live aspen will reduce suckering.
Shelterwood	NR	Aspen is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	R	
Tree-length	R	Potential for heavy slash loadings will influence effectiveness of site preparation. Slash remaining on the site will also reduce soil temperature and sucker production.
Cut-to-length/Shortwood	R	See Tree-length comment. Concentration of slash in rows by single grip harvesters will create an uneven distribution of aspen suckers.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

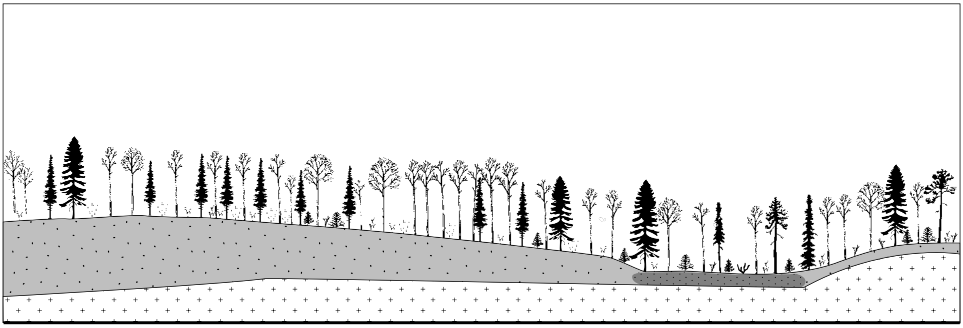
Silvicultural Interpretations for the Establishment of Aspen (con't)

Renewal Treatments	Comments	
Site Preparation • Mechanical	NR	See Scarification (Section II, Book I).
• Chemical	R	Chemical site preparation may be used on sites where the residual overstorey will negatively affect root suckering. 2,4-D is recommended since it will remove the overstorey without damaging the aspen root systems.
• Prescribed Burn	R	
Regeneration • Natural - Advance Growth	NR	Aspen does not regenerate under a closed canopy.
- Seed	NR	Aspen regeneration from seed is highly variable.
- Vegetative (coppice)	R	There may be insufficient aspen on this site to achieve management objectives.
• Artificial - Planting	NR	Insufficient data and/or field experience exist to recommend this technique. Planting of aspen seedlings may be considered when existing aspen has deteriorated to a point where vegetative regeneration is unlikely or undesirable.
- Seeding	NR	Insufficient data and/or field experience exist to recommend this technique.
- Scarification	R	There may be insufficient aspen on this site to achieve management objectives.
Tending Treatments		
Cleaning		Moderate to high competition on this site. High initial densities and rapid early growth of aspen suckers will ensure their successful renewal.
• Manual	NR	
• Mechanical	NR	
• Chemical - Ground	NR	
- Aerial	NR	
Spacing	R	Site quality and timing is critical for the success of this treatment.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

ES 19

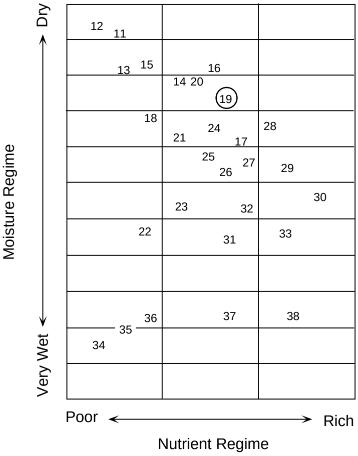
Hardwood–Fir–Spruce Mixedwood: Fresh, Sandy–Coarse Loamy Soil



approximately 250 m

General Description

Dominated by trembling aspen, white birch and balsam fir, with occasional occurrences of white and black spruce. Deciduous tree component exceeds 50% of the canopy. Understory composition variable; shrub- and herb-rich. Soils are fresh, well drained, coarse loamy to fine sandy. Parent materials are commonly glaciofluvial on deep soil sites and morainal on shallow sites. Ground cover consists of broadleaf litter, conifer litter, wood and feathermoss.



Soil Types
S3, S2, SS6, SS5, S1

Mode of Deposition
glaciofluvial, morainal

Humus Form
fibrimor, humifibrimor

Overstorey
trembling aspen, white birch, white spruce, black spruce, jack pine, balsam fir

Shrubs/Trees (<10 m)
Acer spicatum, Corylus cornuta, Diervilla lonicera, Lonicera canadensis, Linnaea borealis, balsam fir, white spruce, Sorbus decora, trembling aspen

Herbs and Graminoids
Aster macrophyllus, Aralia nudicaulis, Mitella nuda, Streptopus roseus, Viola renifolia, Galium triflorum, Clintonia borealis, Trientalis borealis, Maianthemum canadense, Cornus canadensis, Actaea rubra

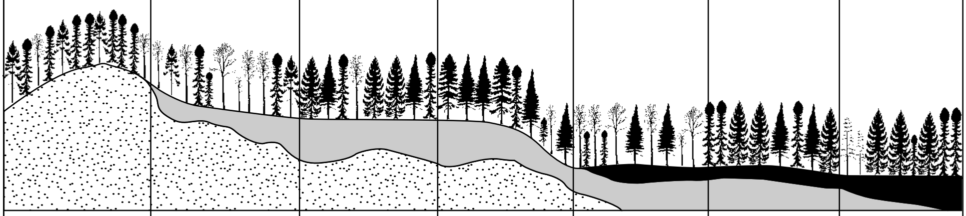
Mosses and Lichens
Pleurozium schreberi, Ptilium crista-castrensis, Hylocomium splendens, Rhytidiadelphus triquetrus

Comments

Conifer component of overstory typically quite variable. Characteristic V-types include V4, V5, V6, V7, V8, V9, V10 and V11. Expect to see pockets of V1 or V2 in lower areas, grading to V14, V15 and V17 as conifer concentration increases locally. May include tolerant hardwoods such as yellow birch, red maple and sugar maple in Site Regions 4S, 4W and 5S.

Typical Landscape Associations

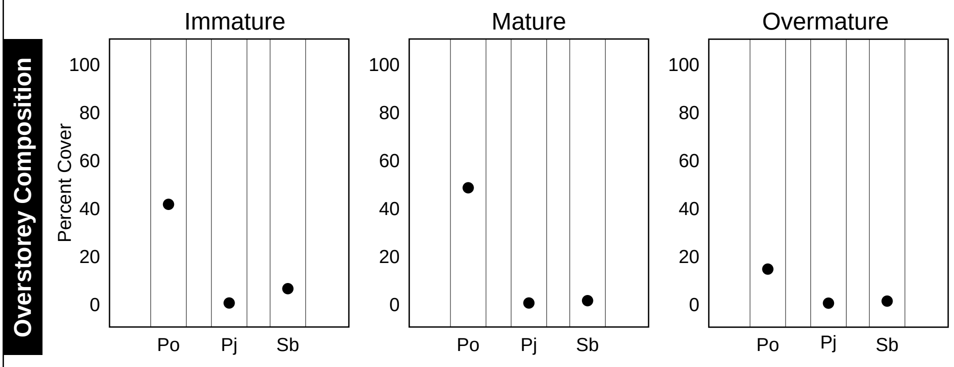
Typical Ecosite Sequence on Very Shallow to Deep Coarse Loamy Till Material

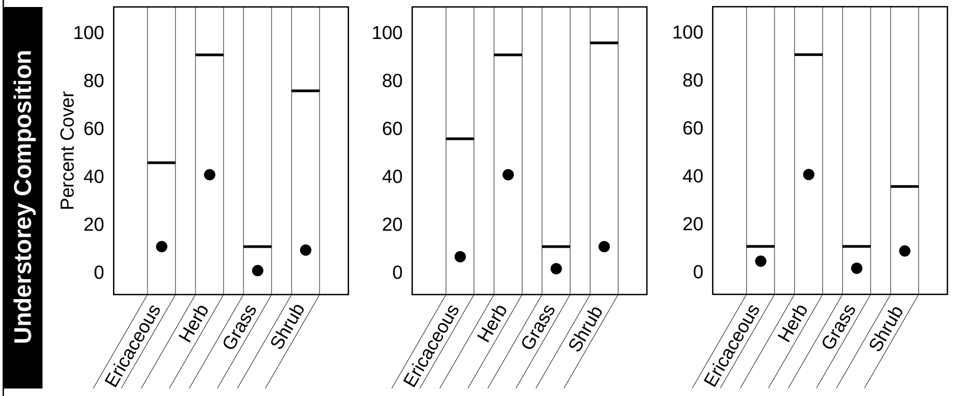


Sb-Pj (Po)	Po-Sb-Pj (Bw)	Ce-Bf (Sb-Po)	Bf-Sw (Po-Sb)	Po-Bf-Bw (Sb)	Ce-Sb (Bf)	Ce-Sb (Ta)
ES12 Black Spruce-Jack Pine: Very Shallow Soil	ES19 Hardwood-Fir-Spruce Mixedwood: Fresh, Sandy-Coarse Loamy Soil	ES17 White Cedar: Fresh-Moist, Coarse-Fine Loamy Soil	ES21 Fir-Spruce Mixedwood: Fresh, Coarse Loamy Soil	ES23 Hardwood-Fir-Spruce Mixedwood: Moist, Sandy-Coarse Loamy Soil	ES17 White Cedar: Fresh-Moist, Coarse-Fine Loamy Soil	ES37 Rich Swamp: Cedar (Other conifer): Organic Soil
V30 Jack Pine-Black Spruce/ Blueberry/Lichen	V11 Trembling Aspen-Conifer/Blueberry/ Feathermoss	V21 Cedar (inc. Mixedwood)/ Mountain Maple	V16 Balsam Fir-White Spruce Mixedwood/ Feathermoss	V6 Trembling Aspen (White Birch)-Balsam Fir/ Mountain Maple	V21 Cedar (inc. Mixedwood)/ Mountain Maple	V22 Cedar (inc. Mixedwood)/ Speckled Alder/ Sphagnum
SS2 Exremely Shallow Soil on Bedrock	SS6 Shallow-Moderately Deep/ Coarse Loamy	S3 Fresh/ Coarse Loamy	S3 Fresh/ Coarse Loamy	S8 Moist/ Coarse Loamy	S8 Moist/ Coarse Loamy	S12S Wet/Organic (Sphagnum)
Dry	Dry-Fresh	Fresh	Fresh	Moist	Moist	Wet

Site Structure and Composition

Forest Stage





Advance Growth	Forest Stage					
	Immature		Mature		Overmature	
	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)
Sb	0	N/A	2200	N/A	2732	N/A
Bf	2083	N/A	1054	N/A	1841	N/A

Seedbed															
	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen
	0	11	88	0	1	0	11	81	7	1	0	11	82	6	1

Coarse Woody Debris						
	Logs	Debris	Logs	Debris	Logs	Debris
	N/A	N/A	N/A	N/A	N/A	N/A

Vegetation and Soil Type Relationships

(number of plots with defined combinations)

4 White Birch Hardwood and Mixedwood	5 Aspen Hardwood	6 Trembling Aspen (White Birch) – Balsam Fir / Mountain Maple	7 Trembling Aspen – Balsam Fir / Balsam Fir Shrub	8 Trembling Aspen (White Birch) / Mountain Maple	9 Trembling Aspen Mixedwood	10 Trembling Aspen – Black Spruce – Jack Pine / Low Shrub	11 Trembling Aspen – Conifer / Blueberry / Feathermoss		
▨	▨	▨	□	▨	▨	▨	▨		
7	8	5	3	8	2	12	9	□	S1 – Dry / Coarse Sandy
9	10	9	6	5	5	8	6	▨	S2 – Fresh / Fine Sandy
17	13	21	1	10	8	7	7	▨	S3 – Fresh / Coarse Loamy
2	3	1		1	1	4	3	□	SS5 – Shallow – Moderately Deep / Sandy
11	5	4	4	3	4	4	2	□	SS6 – Shallow – Moderately Deep / Coarse Loamy

Description of Soil and Vegetation

▨ Characteristic Common

■ Common Inclusions

□ Characteristic Uncommon

Selected Species Habitat Use

	Forest Stage					
Species	Pre-sapling	Sapling	Immature	Mature	Overmature	Special Habitat Preferences
Spruce Grouse						
Great Grey Owl						
Black-backed Woodpecker				○	○	snags
Pileated Woodpecker				○	●	snags, downed woody debris
Least Flycatcher				○	○	often found near open spaces (edge, riparian)
Boreal Chickadee				○	○	snags
Swainson's Thrush			●	●	●	
Nashville Warbler		○	○	○		high level of light penetration, preferably with shallow undergrowth
Connecticut Warbler						
White-throated Sparrow	○	○			○	numerous openings with low dense vegetation
Northern Flying Squirrel				○	○	snags
Southern Red-backed Vole		○	○	○	○	downed woody debris
Meadow Vole						
Marten			○	○	○	snags, downed woody debris
Woodland Caribou (winter)						
Woodland Caribou (hab. rank)						
White-tailed Deer (forage)	○	○			○	
White-tailed Deer (cover)			○	○	○	
Moose (forage)	○	○	○	○	○	
Moose (cover)			○	○	○	

○ Used Habitat ● Preferred Habitat

Successional Relationships - Natural

These stands are often dominated by trembling aspen or white birch in the canopy. Pure upper canopies of either hardwood are possible, but white spruce, balsam fir, black spruce and/or the other hardwood are occasional codominants. Total tree cover remains high during much of this stands existence. When aspen dominates in the canopy, balsam fir, white spruce and white birch are commonly encountered in the sub-canopy. When mono-dominants of trembling aspen occur, balsam fir usually dominates in the understorey. The tall and low shrub layers are usually dominated by balsam fir although white birch and black spruce can also occur. In contrast, when white birch dominates the main canopy, jack pine is often a significant component of the main canopy—especially on shallow (<2 m depth) and rapidly-drained sandy soils. Stand age varies from 40 to 167 years with the majority of sites occurring in the 40 to 100 year range.

The tall and low shrub layers beneath an aspen dominated stand are often dominated by *Acer spicatum* and *Corylus cornuta*; *Diervilla lonicera* is present in the low shrub layer at high cover. *Acer spicatum* is replaced by *Alnus crispa* in stands dominated by white birch. Tall shrubs are frequent and occur at moderate cover in most stands. The herb layer is floristically rich and herb cover is high. *Aster macrophyllus* and *Aralia nudicaulis* are the most abundant herbs.

In the absence of the spruce budworm, the overall successional trajectory for these stands is toward a more open, multi-tiered and uneven-aged canopy of mixed species composition. Canopy cover increases up to age 100 years and then begins to decline as the intolerant hardwoods begin to ‘fall out’ of the canopy. The hardwood component is slowly replaced by coniferous species, particularly, white and black spruce, and balsam fir. The oldest stands are uneven-aged and show strong conifer regeneration in the sub-canopy and seedling layers. Residual aspen stems from the original stand may persist for 200 years or more on moist sites. White birch persists in the sub-canopy of some stands - the result of light, surface fires beneath the main canopy. At extended rotations, white spruce will form a super-canopy with a main canopy of balsam fir, white birch and black spruce.

Black spruce may be favored by gap creation created through stand breakup of the white birch dominated mixed woods. Likewise, balsam fir is favored by gap creation in trembling aspen dominated mixed woods. At even older ages (140 years) and in the absence of fire, sparse regeneration of the hardwood components results in an increasing dominance by woody shrubs such as *Acer spicatum* and shade tolerant conifers such as balsam fir. The balsam fir sub-canopy component in aspen dominated stands eventually grows through into the main canopy; in contrast, it is black spruce which dominates in the older birch mixed woods. Species richness, diversity and evenness increase marginally over time. Mean tree species richness, diversity and evenness all increase over time, indicating the increasingly ‘mixed’ nature of the canopy-sub-canopy as stands age.

The cover of tall shrubs and *Diervilla lonicera* generally declines with increasing age whereas *Vaccinium* spp. increases in abundance and distribution. Suckering by trembling aspen is common, but these individuals seldom enter the sub-canopy. Herb cover declines after 100 years reflecting the increase in canopy cover by conifers and the associated change in light conditions and the geochemistry of the forest floor.

Successional Relationships - Post-harvest

Response following harvest:

Post-harvest successional patterns are extremely complex to predict due to the combined interaction of soil/site conditions, original stand conditions, season of harvest and severity and duration of the harvest activity. Following harvest, aspen and white birch increase in density and dominance due to rapid sprouting and suckering. Removal of the overstorey results in the reproduction and growth of wood shrubs and the herbaceous layer. This site is slightly more moist and rich than ES16 and the vigor of woody shrub re-growth is enhanced.

The protection of conifer advance growth often will result in stand development patterns and compositions similar to that following wildfire; however, the prevalent species in the post-logging cover type is balsam fir due to lack of a spruce seed source and a sufficient quantity and quality of receptive seedbed for white and black spruce. This ecosite has a low probability of sufficient number and distribution of black spruce advance growth to form a significant component of the new stand. Careful logging techniques will result in a mixedwood stand condition where balsam fir is a significant component.

Response following harvest and mechanical site preparation:

Following harvest, aspen and white birch increase in density and dominance due to rapid sprouting and suckering. Removal of the overstorey results in the reproduction and growth of wood shrubs and the herbaceous layer. Mechanical site preparation stimulates hardwood suckering and sprouting of shrubs - especially *Corylus cornuta* by stimulating reproduction from underground sprouts. Disc trenching, blading and use of a brush blade will reduce the cover and abundance of the *Corylus cornuta* but will have minimal effect on *Acer spicatum*. The cover by herbs also increases. However, mechanical site preparation on these sites is very effective in reducing the proportion of balsam fir in the new stand arising from advance growth present at time of harvest. Post-harvest advance regeneration of balsam fir which survives following mechanical site preparation is generally of poor quality. Overall, mechanical site preparation will create a successional shift to favor hardwoods.

Response following harvest and prescribed fire:

High intensity severe prescribed burns will effectively reduce the density and dominance of aspen and white birch in the regeneration phase as well as *Acer spicatum* and *Corylus cornuta*. Low intensity prescribed fire will stimulate the regeneration of the *Corylus cornuta* but repeat summer fires will exhaust stored food reserves and reduce its ability to re-sprout. Prescribed fire is successful in eliminating balsam fir regeneration and advance growth; the degree of impact is related to severity and intensity of the burn.

Site Productivity

Site Index by species and NWO FEC Soil Type
Site Index (breast height age 50 years)

Soil Type	Species		
	Sb	Pj	Po
S1	13.0	18.3	19.3
S2	11.9	16.9	20.1
S3	14.8	17.5	17.7
SS5	10.8	16.2	16.9
SS6	13.6	16.7	17.9

Black Spruce Advance Regeneration

	Vegetation Type						
	V4	V5	V6	V8	V9	V10	V11
Stocking (%)	6	3	N/A	3	10	8	17
Stocking Range	0 – 35	0 – 20	N/A	0 – 6	0 – 25	0 – 25	0 – 75
Stems per ha	3900	200	N/A	100	900	700	1200

V10, V11 and V5 are the characteristic vegetation types with V4, V6, V8, and V9 as common inclusions on this ecosite.

Trembling aspen dominates the ecosite with varying amounts of balsam fir, white birch, white spruce, black spruce and jack pine.

This ecosite has a low probability of sufficient number and distribution of black spruce advance growth to regenerate the site.

The number and distribution of black spruce advance growth on this ecosite is positively related to:

- basal area of black spruce in the original stand

and inversely related to:

- percent cover of herbaceous species
- percent cover of broadleaf litter
- percent canopy closure

Natural Ingress Probability and Density (ten years post-disturbance)

Information not available

Critical Comments

- Woody shrub and hardwood tree competition from aspen, mountain maple, beaked hazel and balsam fir on V5, V6, V7, V8, V9, V10, V11, V17, and V18. White birch will be a significant component of any portion of this ecosite dominated by V4; aspen a significant component on all other sites.
- Most tree species will be highly susceptible to *Armillaria* spp. on this site. Balsam fir, white spruce and black spruce may also be susceptible to *Inonotus tomentosus* on the same sites where *Armillaria* spp. occurs.
- Stands are vulnerable to spruce budworm if the proportion of balsam fir and white spruce in the stands exceeds 20 percent of the total crown volume.
- Soil/site conditions limit the use of hexazinone products for chemical site preparation.
- Natural regeneration of black spruce and jack pine limited by available local seed supply and lack of suitable supply and duration of receptive seedbed.

Site Characteristics, Limitations and Hazard Potential

Characteristics							Limitations				Hazard Potential				
LFH Layer	Soil Texture	Depth to Bedrock	Stoniness	Moisture Regime	Terrain	Competition	Windthrow	Frost Heaving	Drought/Desiccation	Seasonal Flooding	Compaction	Rutting	Soil Erosion	Biomass & Nutrient Removal	Silvicultural Activities
	3		3												Harvesting
1	2		3			4									Renewal
	2					4									Tending

Footnotes:

1. LFH layer is a poor seedbed.
2. Coarse textured soils are nutrient poor.
3. Potential for high surface stone content may limit equipment operability.
4. High competition with mountain maple, beaked hazel and aspen as the principle competitors.

Opportunities

- This site is productive for all major tree species.
- Low levels of natural conifer regeneration, combined with high competition levels, make planting of larger stock the preferred option for maintaining a significant conifer component on this ecosite.
- Option to selectively harvest and underplant white spruce.

Silvicultural Intensity Considerations

Species Objective	Site Productivity	Degree of Effort to Reach Free-to-grow
Black spruce	1 – 2	3
Jack pine	1 – 2	2
Aspen	2	1

Site Productivity - Site Productivity class (prime land productivity class) based upon height of dominant trees at age 50 years (breast height).

Degree of Effort

1 = Extensive
2 = Basic
3 = Intensive
4 = Highly Intensive

Silvicultural Interpretations for the Establishment of Black Spruce

Silvicultural System **• Harvest Method**	**Comments**	
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	R	Residual stand will not contribute seed of sufficient quantity. However, this cutting technique may be prescribed to meet other management objectives.
- Patch	R	See Strip/Block comment.
- Seed-tree	NR	Potential for natural seeding is very low due to infrequent occurrence of black spruce in the original stand.
Shelterwood	NR	Black spruce is mid-tolerant to shade and is susceptible to windthrow after thinning of closed canopy stands.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	R	
Tree-length	R	Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	R	See Tree-length comment.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Black Spruce (con't)

Renewal Treatments	Comments	
Site Preparation		High competition on this site.
• Mechanical	R	Techniques, timing and sequencing of treatments should be carefully considered. Chemi-mechanical site preparation should be considered. Potential for standing dead and down woody debris resulting from repeat spruce budworm infestation is high and will affect equipment operability and effectiveness.
• Chemical	R	Some herbicide-resistant non-crop species may occur on this site.
• Prescribed Burn	R	Severity of burn will affect vegetation response.
Regeneration • Natural - Advance Growth	NR	Black spruce advance growth is not of sufficient quantity or distribution to regenerate the site.
- Seed	NR	Insufficient data exist. Site conditions imply very low levels of black spruce ingress.
- Vegetative (coppice)	NR	Black spruce does not coppice.
• Artificial - Planting	R	
- Seeding	NR	Smothering of seedbeds with hardwood litter will limit success. In addition, the distribution, abundance and vigor of non-crop vegetation will preclude the survival and growth of seed origin black spruce.
- Scarification	NR	Insufficient data exist. Site conditions imply very low levels of black spruce ingress.
Tending Treatments		
Cleaning		High competition on this site.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing is usually not necessary since black spruce natural regeneration is minimal.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine

Silvicultural System **• Harvest Method**		**Comments**
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	R	Residual stand will not contribute seed of sufficient quantity or genetic quality. However, this cutting technique may be prescribed to meet other management objectives.
- Patch	R	See Strip/Block comment.
- Seed-tree	NR	Potential for natural seeding is very low due to infrequent occurrence of jack pine in the original stand.
Shelterwood	NR	Jack pine is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	R	
Tree-length	R	Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	R	See Tree-length comment.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine (con't)

Renewal Treatments	**Comments**	
Site Preparation		High competition on this site.
• Mechanical	R	Techniques, timing and sequencing of treatments should be carefully considered. Chemi-mechanical site preparation should be considered. Potential for standing dead and down woody debris resulting from repeat spruce budworm infestation is high and will affect equipment operability and effectiveness.
• Chemical	R	Some herbicide-resistant non-crop species may occur on this site.
• Prescribed Burn	R	Severity of burn will affect vegetation response.
Regeneration • Natural - Advance Growth	NR	Jack pine does not regenerate under a closed canopy.
- Seed	NR	Potential for natural seeding is very low due to infrequent occurrence of jack pine in the original stand.
- Vegetative (coppice)	NR	Jack pine does not coppice.
• Artificial - Planting	R	
- Seeding	CR	Shelter seeding only. Good selection of seedbed micro-sites will contribute to success. Smothering of seedbeds with hardwood litter will limit success. The distribution, abundance and vigor of competitive non-crop vegetation will affect the survival and growth of seed origin jack pine.
- Scarification	NR	Insufficient data exist. Cone supply is very low due to infrequent occurrence of jack pine in the original stand. Regeneration levels associated with cone scattering will be highly variable.
Tending Treatments		
Cleaning		High competition on this site.
• Manual	R	Cutting will stimulate sprouting and suckering.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing is usually not necessary since jack pine natural regeneration is minimal.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Aspen

Silvicultural System • Harvest Method	Comments	
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	CR	Strips should be at least 20 m wide to warm the soil and stimulate suckering. Strip cutting can also be prescribed to meet other management objectives.
- Patch	CR	Openings 0.4 ha in size are the minimum acceptable to stimulate aspen suckering. Patch cutting can also be prescribed to meet other management objectives.
- Seed-tree	NR	Leaving live aspen will reduce suckering.
Shelterwood	NR	Aspen is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	R	
Tree-length	R	Potential for heavy slash loadings which will influence effectiveness of site preparation. Slash remaining on the site will also reduce soil temperature and sucker production.
Cut-to-length/Shortwood	R	See Tree-length comment. Concentration of slash in rows by single grip harvesters will create an uneven distribution of aspen suckers.

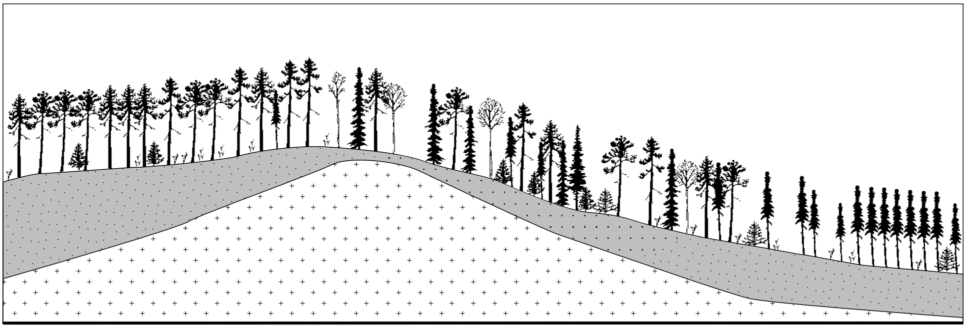
R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Aspen (con't)

Renewal Treatments	Comments	
Site Preparation • Mechanical	NR	See Scarification (Section II, Book I).
• Chemical	R	Chemical site preparation may be used on sites where the residual overstorey will negatively affect root suckering. 2,4-D is recommended since it will remove the overstorey without damaging the aspen root systems.
• Prescribed Burn	R	
Regeneration • Natural - Advance Growth	NR	Aspen does not regenerate under a closed canopy.
- Seed	NR	Aspen regeneration from seed is highly variable.
- Vegetative (coppice)	R	
• Artificial - Planting	NR	Insufficient data and/or field experience exist to recommend this technique. Planting of aspen seedlings may be considered when existing aspen has deteriorated to a point where vegetative regeneration is unlikely or undesirable.
- Seeding	NR	Insufficient data and/or field experience exist to recommend this technique.
- Scarification	R	
Tending Treatments		
Cleaning		High competition on this site. High initial densities and rapid early growth of aspen suckers will ensure their successful renewal.
• Manual	NR	
• Mechanical	NR	
• Chemical - Ground	NR	
- Aerial	NR	
Spacing	R	Site quality and timing is critical for the success of this treatment.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

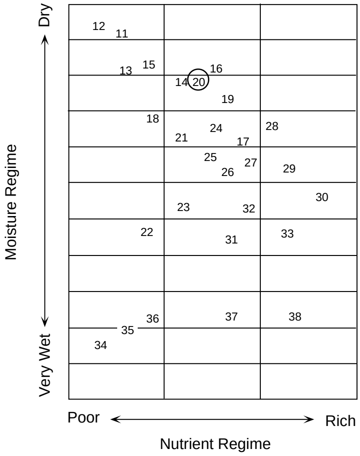
ES 20 Spruce–Pine / Feathermoss: Fresh, Sandy–Coarse Loamy Soil



approximately 250 m

General Description

Overstory dominated by black spruce and jack pine. Scattered occurrences of trembling aspen, white birch and fir. Usually shrub- and herb-poor, but may be locally rich where silt content is higher. Soils dry to fresh, rapidly to well drained, fine to coarse sandy or coarse loamy. Primarily on morainal and glaciofluvial parent material. Ground cover consists of feathermoss and conifer litter.



Soil Types

S3, SS6, S2, SS5, S1

Mode of Deposition

glaciofluvial, morainal

Humus Form

fibrimor, humifibrimor

Overstorey

black spruce, jack pine, trembling aspen, white birch, balsam fir

Shrubs/Trees (<10 m)

black spruce, *Diervilla lonicera, Linnaea borealis, Vaccinium myrtilloides, Vaccinium angustifolium, Ledum groenlandicum*

Herbs and Graminoids

Clintonia borealis, Aralia nudicaulis, Trientalis borealis, Maianthemum canadense, Cornus canadensis

Mosses and Lichens

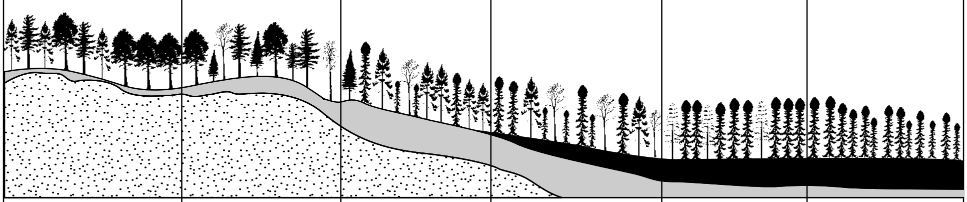
Pleurozium schreberi, Ptilium crista-castrensis, Hylocomium splendens, Dicranum polysetum

Comments

Overstory composition ranges from almost pure pine or spruce to various mixtures. Hardwood species occur with limited cover. Characteristic V-types include V28, V29, V30, V31 V32 and V33. Expect V20, V18 and V17 in patches where hardwood cover increases and ecosite grades into ES21.

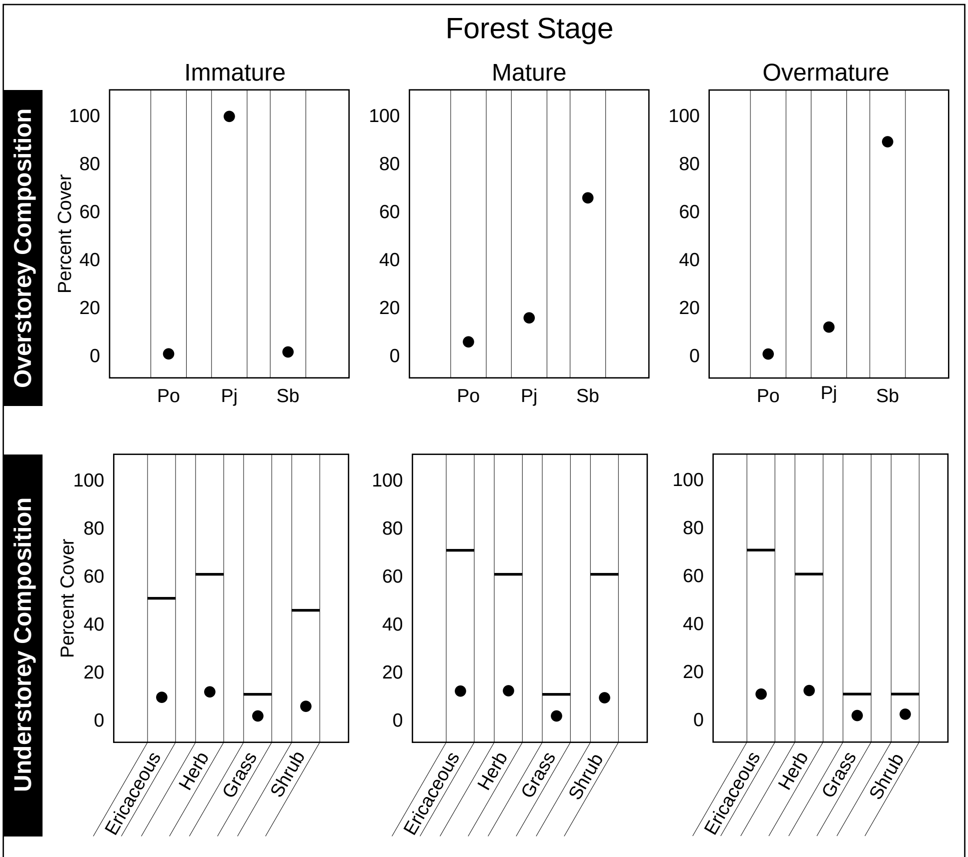
Typical Landscape Associations

Typical Ecosite Sequence on Very Shallow to Deep Coarse Loamy Till Material



Pr-Pw (Pj)	Pw-Pr-Bw (Po)	Pj-Sb (Bf-Bw)	Sb-Bw (Pj)	Sb (Ta)	Sb
ES11 Red Pine-White Pine-Jack Pine: Very Shallow Soil	ES18 Red Pine-White PIne: Fresh, Coarse Loamy Soil	ES20 Spruce-Pine/ Feathermoss: Fresh, Sandy-Coarse Loamy Soil	ES22 Spruce-Pine/ Ledum/ Feathermoss: Moist, Sandy-Coarse Loamy Soil	ES35 Poor Swamp: Black Spruce: Organic Soil	ES34 Treed Bog: Black Spruce/ Sphagnum: Organic Soil
V12 White PIne Mixedwood	V13 Red PIne Mixedwood	V18 Jack Pine Mixedwood/ Feathermoss	V20 Black Spruce Mixedwood/ Feathermoss	V34 Black Spruce/ Labrador-tea/ Feathermoss (Sphagnum)	V38 Black Spruce/ Leatherleaf/ Sphagnum
SS3 Very Shallow Soil on Bedrock	SS6 Shallow-Moderately Deep/ Coarse Loamy	S3 Fresh/ Coarse Loamy	S8 Moist/ Coarse Loamy	S12F Wet/Organic (Feathermoss)	S12S Wet/Organic (Sphagnum)
Dry	Dry-Fresh	Fresh	Moist	Wet	Wet

Site Structure and Composition



Advance Growth	Forest Stage					
	Immature		Mature		Overmature	
	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)
Sb	479	N/A	362	N/A	464	N/A
Bf	2424	N/A	3055	N/A	679	N/A

Seedbed															
	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen
	1	32	0	64	3	1	32	0	64	3	1	32	0	64	3

Coarse Woody Debris						
	Logs	Debris	Logs	Debris	Logs	Debris
	N/A	N/A	N/A	N/A	N/A	N/A

Vegetation and Soil Type Relationships

(number of plots with defined combinations)

Jack Pine / Low Shrub 28	Jack Pine / Ericaceous Shrub / Feathermoss 29	Jack Pine – Black Spruce / Blueberry / Lichen 30	Black Spruce – Jack Pine / Tall Shrub / Feathermoss 31	Jack Pine – Black Spruce / Ericaceous Shrub / Feathermoss 32	Black Spruce / Feathermoss 33		
▨	□	□	▨	▨	▨		
13	17	3	8	40	7	□	S1 – Dry / Coarse Sandy
2	23	7	14	30	14	▨	S2 – Fresh / Fine Sandy
2	5	1	12	12	11	▨	S3 – Fresh / Coarse Loamy
2	1	3	1	3	5	□	SS5 – Shallow – Moderately Deep / Sandy
5	5	10	8	21	16	▨	SS6 – Shallow – Moderately Deep / Coarse Loamy

Description of Soil and Vegetation

▨ Characteristic Common

■ Common Inclusions

□ Characteristic Uncommon

Selected Species Habitat Use

	Forest Stage					
Species	Pre-sapling	Sapling	Immature	Mature	Overmature	Special Habitat Preferences
Spruce Grouse			○	○	○	
Great Grey Owl						
Black-backed Woodpecker						
Pileated Woodpecker						
Least Flycatcher						
Boreal Chickadee				○	○	snags
Swainson's Thrush			○	○	○	
Nashville Warbler		○	○	○		high level of light penetration, preferably with shallow undergrowth
Connecticut Warbler	○	○				nests in spruce bogs/tamarack fens with well developed understorey
White-throated Sparrow	○	○			○	numerous openings with low dense vegetation
Northern Flying Squirrel				○	○	snags
Southern Red-backed Vole		○	○	●	●	downed woody debris
Meadow Vole	○					fields, grassy meadows
Marten			○	●	●	snags, downed woody debris
Woodland Caribou (winter)				○	○	arboreal lichens
Woodland Caribou (hab. rank)			●	●	●	
White-tailed Deer (forage)						
White-tailed Deer (cover)						
Moose (forage)	○	○				
Moose (cover)			○	○	○	

○ Used Habitat ● Preferred Habitat

Successional Relationships - Natural

This ecosite is characterized by a closed, mixed jack pine - black spruce canopy. Jack pine is almost exclusively found in the canopy, whereas black spruce is distributed throughout the canopy, sub-canopy and sapling layers. Jack pine recruitment is restricted to the first few years after fire while black spruce recruitment continues for at least 60 years post catastrophic disturbance. White birch, balsam fir, trembling aspen and/or white spruce may be occasionally present in the upper two canopies, but they are uncommon. Stand ages range from 45 to 186 years with the majority of sites occurring between 70 to 115 years of age.

Total shrub cover is low, and ericaceous shrubs predominate (mainly *Vaccinium* spp., *Gaultheria hispidula* and *Ledum groenlandicum*). When *Ledum groenlandicum* is present it generally occurs at moderate to high cover. Tall shrubs are of minor importance on these ecosites. *Alnus crispa* is the usual tall shrub found on ES20. and Non-ericaceous shrubs and herbs occur with low frequency and/or cover. The forest floor is primarily covered by *Pleurozium schreberi* although *Dicranum polysetum* and *Ptilium crista-cristensis* are also frequent. Species richness, diversity and evenness are low compared to the other ecosites.

The successional trajectory indicates increased dominance by black spruce, in both the canopy and sub-canopy layers. Unlike ES12, black spruce recruitment into the stand remains strong and total canopy cover does not declines over time. Recruitment of black spruce is initially contemporaneous with jack pine and then becomes gradual or episodic. Episodic recruitment usually follows low-intensity surface fire. This results in a dense, uneven-aged monodominant black spruce stand. Some relict jack pine may occur in older stands. White birch which may show moderate to strong regeneration in more open canopy sites and/or in areas of windthrow, persists in some older stands.

Tall and low shrub cover will decline over time after 100 years as canopy closure is maintained. Herb cover declines steadily. Moss species continue to dominate the forest floor. The exception is *Vaccinium angustifolium* and *Linnaea borealis* which retain their presence and relatively high abundance in the low shrub layer. Total herb cover is generally less than that of shrubs and also declines, particularly in older stands.

Successional Relationships - Post-harvest

Response following harvest:

The presence of a viable black spruce or jack pine seed source from residuals or adjacent stands will contribute to the perpetuation of those species on this ecosite. Jack pine in the original stand will make the likelihood of jack pine ingress greater. An aspen component present in the original canopy is likely to be maintained through vegetative suckering.

The probability of natural ingress from both jack pine and black spruce and trembling aspen ten-years following disturbance from logging is high. Jack pine ingress is complete five years following disturbance and removal of the canopy. Fifty percent of the ingress establishes itself within one year after disturbance. In contrast, black spruce has an extended period of establishment; full and half ingress for black spruce is not achieved until nine and six years after disturbance, respectively.

Likewise a moderate probability exists for black spruce advance growth to occur in the understorey in the undisturbed stand. Stocking of black spruce and balsam fir in the sub-canopy or as advance growth in the understorey will be greatly reduced following canopy removal due to exposure, sunscald and increased droughtiness of the site.

Proliferation of woody shrubs is uncommon but the presence and cover of ericaceous shrubs in deeper soil pockets will be enhanced. Exposed feathermoss quickly dies following removal of the overstorey.

Response following harvest and mechanical site preparation:

Disturbance and mixing of the LFH with mineral soil will create suitable seedbed for black spruce and jack pine. If jack pine is present in the original stand, its presence in the future stand may be enhanced by scarification on the site. Soil disturbance will stimulate the establishment and growth of woody shrubs and will stimulate hardwood suckering especially from aspen. Buried branch parts will root and revegetate new plants. Ericaceous shrubs will increase in abundance by sprouting from rhizomes.

Response following harvest and prescribed fire:

Following fire, the growth of ericaceous shrubs (blueberry) and herbs (fireweed) is stimulated. These species can quickly dominate the site within two years. Moderate to high intensity surface fires will be effective in reducing future competition from woody shrubs and exposing a mineral soil seedbed suitable for conifer establishment. Prescribed fire will destroy any black spruce or balsam fir advance growth and will usually girdle any seedling jack pine. Moderate to severe intensity surface fires will completely remove the surface organic horizons and kill any hardwood shrubs or aspen present on the cutover.

Ericaceous shrubs will sprout following light intensity fires but sprouting is suppressed by high intensity, severe fires.

Site Productivity

Site Index by species and NWO FEC Soil Type
Site Index (breast height age 50 years)

Soil Type	Species		
	Sb	Pj	Po
S1	13.0	18.3	19.3
S2	11.9	16.9	20.1
S3	14.8	17.5	17.7
SS5	10.8	16.2	16.9
SS6	13.6	16.7	17.9

Black Spruce Advance Regeneration

	Vegetation Type			
	V28	V29	V32	V33
Stocking (%)	6	34	32	24
Stocking Range	0 – 30	5 – 70	0 – 80	0 – 85
Stems per ha	300	4700	3100	2500

V28 and V32 are the characteristic vegetation types with V29 and 33 as common inclusions.

This ecosite is dominated by black spruce and jack pine with scattered stems of other species.

Where black spruce dominates the original stand, there is a moderate possibility of advance growth being present in numbers and distribution to regenerate the site.

The number and distribution of black spruce advance growth on this ecosite is positively related to:

- basal area of black spruce in the original stand

and inversely related to:

- percent cover of herbaceous species
- percent cover of broadleaf litter
- percent canopy closure

Natural Ingress Probability and Density (ten years post-disturbance)

Seedbed Condition	Species and Height Class					
	Sb		Pj		Po	
	< 1.0	> 1.0	< 1.0	> 1.0	< 1.0	> 1.0
Duff	X ▒	H ░	X ░	X ▓	H ░	H ▒
Mineral Soil	Insufficient Data					
Burned	Insufficient Data					

Probability Class

V- < 21%
L- 21 - 40%
M- 41 - 60%
H- 61 - 80%
X- > 80%

Density Class

□ < 300
░ 300 - 1000
▒ 1001 - 5000
▓ 5001 - 10000
█ > 10000

- This ES supports abundant natural regeneration of all three major species.
- Jack pine dominates the overstorey, both in terms of density and time of establishment. Jack pine ingress is complete five years after disturbance, and half of it establishes within one year after disturbance.
- Black spruce is the dominant species in the understorey, and has an extended period of establishment. Full and half-ingress is not achieved until nine and six years after disturbance, respectively.
- These results suggest that natural regeneration will provide a two-storied stand, with an overstorey of jack pine and an understorey of black spruce. Eventually, the jack pine will mature and fall out of the overstorey and the black spruce will assume dominance again.

Critical Comments

- Moderate competition may be expected from green alder, willow and aspen (where it exists in the original stand).
- Ecosites supporting V30, V31, V32 and V33 are moderately susceptible to spruce budworm infestation.

Site Characteristics, Limitations and Hazard Potential

Characteristics							Limitations				Hazard Potential				
LFH Layer	Soil Texture	Depth to Bedrock	Stoniness	Moisture Regime	Terrain	Competition	Windthrow	Frost Heaving	Drought/Desiccation	Seasonal Flooding	Compaction	Rutting	Soil Erosion	Biomass & Nutrient Removal	Silvicultural Activities
	2	3											3		Harvesting
1	2	3					3		3				3		Renewal
	2	3													Tending

Footnotes:

1. LFH layer is a poor seedbed.
2. Coarse textured soils are nutrient poor.
3. Shallow soils (20 to 50 cm) susceptible to erosion, seasonal drought/desiccation, windthrow and low nutrient levels.

Opportunities

- Option for jack pine and/or black spruce seed tree and prescribed fire treatment.
- Careful logging to preserve black spruce advance growth, combined with moderate to high levels of jack pine and black spruce ingress, is an effective lower cost regeneration strategy.
- Cone scattering of jack pine with light site preparation is suitable for this low competition site.
- Planting red and white pine on fresher sites possible.
- Planting conifer on sites with shallower organic matter depths will require no site preparation.

Silvicultural Intensity Considerations

Species Objective	Site Productivity	Degree of Effort to Reach Free-to-grow
Black spruce	1 – 2	3
Jack pine	1 – 2	1
Aspen	2	(1)*

Site Productivity - Site Productivity class (prime land productivity class) based upon height of dominant trees at age 50 years (breast height).

Degree of Effort

1 = Extensive
2 = Basic
3 = Intensive
4 = Highly Intensive

Silvicultural Interpretations for the Establishment of Black Spruce

Silvicultural System **• Harvest Method**	**Comments**	
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	R	Site conditions are not conducive to regeneration by this technique. However, this cutting technique may be prescribed to meet other management objectives.
- Patch	R	See Strip/Block comment.
- Seed-tree	R	Group seed tree is the most commonly used technique. Ensure there is adequate distribution of black spruce in the portion of the stand where seed tree system is being prescribed.
Shelterwood	NR	Black spruce is mid-tolerant to shade and susceptible to windthrow after thinning of closed canopy stands.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	R	
Tree-length	R	
Cut-to-length/Shortwood	R	
Renewal Treatments		
Site Preparation		Low competition on this site. Trembling aspen and white birch may be locally abundant.
• Mechanical	R	Techniques, timing and sequencing of treatments should be carefully considered to inhibit establishment of non-crop vegetation.
• Chemical	R	Shrub and herb poor. Chemical site preparation is generally not required.
• Prescribed Burn	R	Severity of burn will affect vegetation response.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Black Spruce (con't)

Renewal Treatments	Comments	
Regeneration • Natural - Advance Growth	R	Moderate levels of advance growth. May require supplemental artificial regeneration.
- Seed	R	Low to moderate levels of black spruce ingress. May require supplemental artificial regeneration.
- Vegetative (coppice)	NR	Black spruce does not coppice.
• Artificial - Planting	R	
- Seeding	R	Moderate potential for aerial seeding. An abundant supply of seed from slash is necessary to supplement the aerial seeding. Use site preparation to create sufficient suitable seedbed.
- Scarification	NR	Low to moderate levels of black spruce ingress.
Tending Treatments		
Cleaning		Low competition on this site and cleaning is not usually required. Trembling aspen and white birch may be locally abundant.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing is usually not necessary since black spruce natural regeneration is minimal.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine

Silvicultural System **• Harvest Method**		**Comments**
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	R	Residual stand will not contribute seed of sufficient quantity or genetic quality. However, this cutting technique may be prescribed to meet other management objectives.
- Patch	R	See Strip/Block comment.
- Seed-tree	CR	Jack pine seed tree systems are only to be used in conjunction with a post-harvest prescribed burn which creates 50% net mineral soil exposure well distributed across the site.
Shelterwood	NR	Jack pine is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	R	
Tree-length	R	Leaving cone-bearing tops on site will contribute to success of natural seeding/scarification treatments for jack pine. See Cut-to-Length/Shortwood comment.
Cut-to-length/Shortwood	R	Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine (con't)

Renewal Treatments	Comments	
Site Preparation		Low competition on this site. Trembling aspen and white birch may be locally abundant.
• Mechanical	R	Techniques, timing and sequencing of treatments should be carefully considered to inhibit establishment of non-crop vegetation.
• Chemical	R	Shrub and herb poor. Chemical site preparation is generally not required.
• Prescribed Burn	R	Severity of burn will affect vegetation response. Prescribed burning is required when using the seed tree silvicultural system.
Regeneration • Natural - Advance Growth	NR	Jack pine does not regenerate under a closed canopy.
- Seed	R	High levels of jack pine ingress.
- Vegetative (coppice)	NR	Jack pine does not coppice.
• Artificial - Planting	R	Natural seed and/or seeding are preferred options. Ingress will preclude density and distribution control obtained from planting.
- Seeding	R	Good distribution of mineral soil seedbeds will contribute to success.
- Scarification	R	Insufficient data exist. Site conditions imply high levels of ingress.
Tending Treatments		
Cleaning		Low competition on this site and cleaning is not usually required. Trembling aspen and white birch may be locally abundant.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing may be required to control crop tree spacing when seeding techniques (artificial or natural) have been employed to establish crop.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Aspen

Silvicultural System **• Harvest Method**	**Comments**	
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	CR	Strips should be at least 20 m wide to warm the soil and stimulate suckering. Strip cutting can also be prescribed to meet other management objectives.
- Patch	CR	Openings 0.4 ha in size are the minimum acceptable to stimulate aspen suckering. Patch cutting can also be prescribed to meet other management objectives.
- Seed-tree	NR	Leaving live aspen will reduce suckering.
Shelterwood	NR	Aspen is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	R	
Tree-length	R	Potential for heavy slash loadings will influence effectiveness of site preparation. Slash remaining on the site will also reduce soil temperature and sucker production.
Cut-to-length/Shortwood	R	See Tree-length comment. Concentration of slash in rows by single grip harvesters will create an uneven distribution of aspen suckers.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

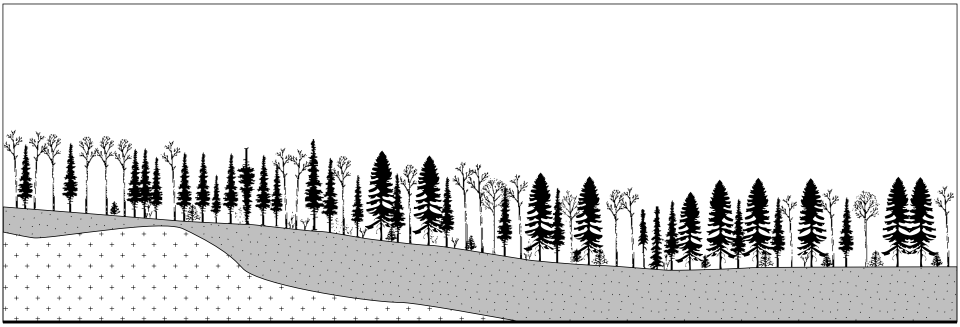
Silvicultural Interpretations for the Establishment of Aspen (con't)

Renewal Treatments	Comments	
Site Preparation • Mechanical	NR	See Scarification (Section II, Book I).
• Chemical	R	Chemical site preparation may be used on sites where the residual overstorey will negatively affect root suckering. 2,4-D is recommended since it will remove the overstorey without damaging the aspen root systems.
• Prescribed Burn	R	
Regeneration • Natural - Advance Growth	NR	Aspen does not regenerate under a closed canopy.
- Seed	NR	Aspen regeneration from seed is highly variable.
- Vegetative (coppice)	R	There may be insufficient aspen on this site to achieve management objectives.
• Artificial - Planting	NR	Insufficient data and/or field experience exist to recommend this technique. Planting of aspen seedlings may be considered when existing aspen has deteriorated to a point where vegetative regeneration is unlikely or undesirable.
- Seeding	NR	Insufficient data and/or field experience exist to recommend this technique.
- Scarification	R	There may be insufficient aspen on this site to achieve management objectives.
Tending Treatments		
Cleaning		Low competition on this site. High initial densities and rapid early growth of aspen suckers will ensure their successful renewal.
• Manual	NR	
• Mechanical	NR	
• Chemical - Ground	NR	
- Aerial	NR	
Spacing	R	Site quality and timing is critical for the success of this treatment.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

ES 21

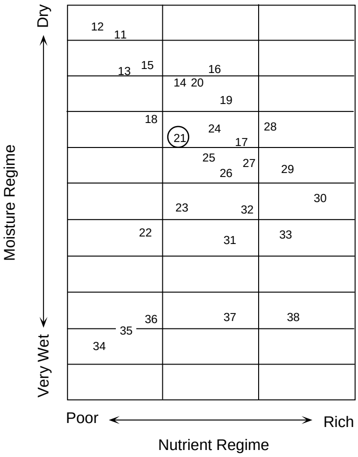
Fir–Spruce Mixedwood: Fresh, Coarse Loamy Soil



approximately 250 m

General Description

Dominated by balsam fir, white spruce and black spruce with mixtures of trembling aspen and white birch. Coniferous component exceeds 50% of the canopy. Typically shrub- and herb-poor with abundant feathermoss; Acer spicatum may be locally abundant. Soils fresh, well drained, coarse loamy. Occurring predominantly on morainal and glaciofluvial material. Ground cover consists of broadleaf litter, feathermoss, conifer and wood.



Soil Types
S3, SS6

Mode of Deposition
morainal, glaciofluvial

Humus Form
fibrimor, humifibrimor

Overstorey
balsam fir, white spruce, black spruce, trembling aspen, white birch

Shrubs/Trees (<10 m)
Acer spicatum, Corylus cornuta, Diervilla lonicera, Lonicera canadensis, Rubus pubescens, Linnaea borealis, balsam fir, white birch, trembling aspen

Herbs and Graminoids
Aster macrophyllus, Streptopus roseus, Aralia nudicaulis, Viola renifolia, Galium triflorum, Clintonia borealis, Trientalis borealis, Maianthemum canadense, Cornus canadensis

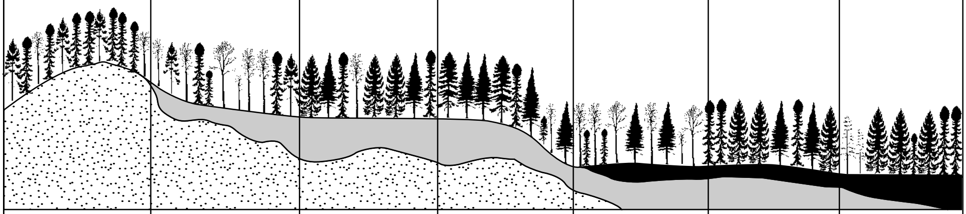
Mosses and Lichens
Pleurozium schreberi, Ptilium crista-castrensis, Hylocomium splendens, Rhytidiadelphus triquetrus

Comments

Extremely variable and dynamic ecosite in terms of forest cover. Characteristic V-types include V14, V15, V16 and V19 but expect to encounter V24 and V25 in patches. Spruce budworm drives many aspects of stand dynamics. This ecosite may also occur on toe and lower slope positions with S2 and occasionally S1 soils. May include tolerant hardwoods such as yellow birch, red maple and sugar maple in Site Regions 4S, 4W and 5S.

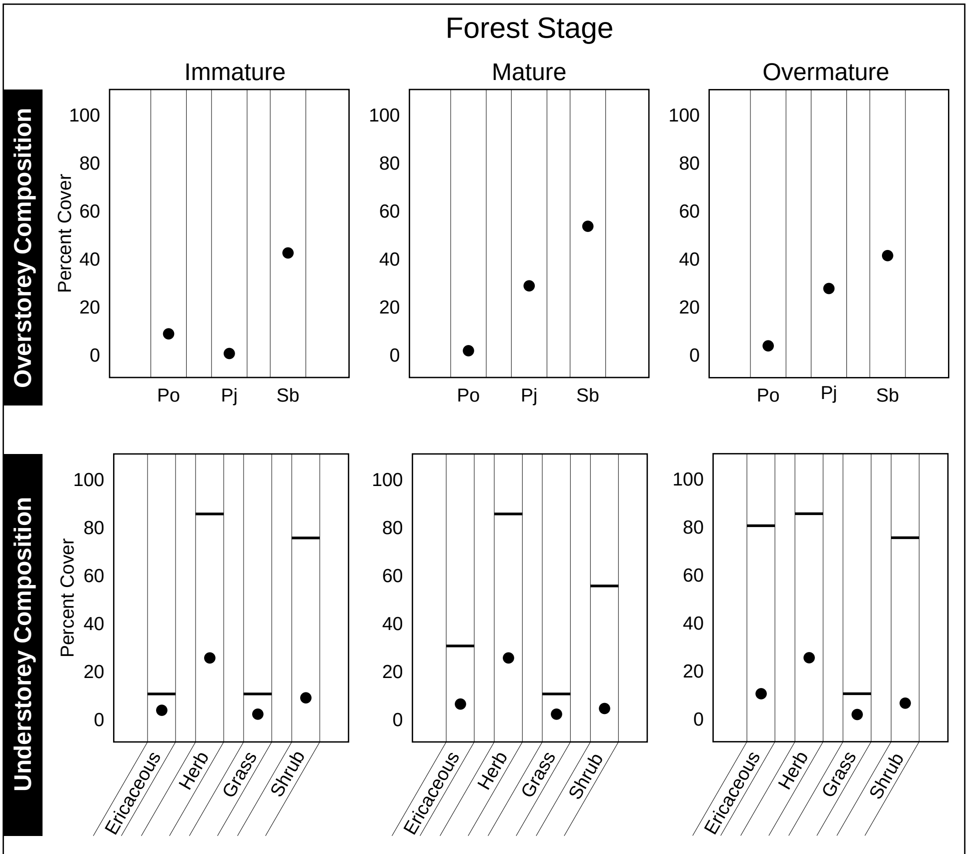
Typical Landscape Associations

Typical Ecosite Sequence on Very Shallow to Deep Coarse Loamy Till Material



Sb-Pj (Po)	Po-Sb-Pj (Bw)	Ce-Bf (Sb-Po)	Bf-Sw (Po-Sb)	Po-Bf-Bw (Sb)	Ce-Sb (Bf)	Ce-Sb (Ta)
ES12 Black Spruce-Jack Pine: Very Shallow Soil	ES19 Hardwood-Fir-Spruce Mixedwood: Fresh, Sandy-Coarse Loamy Soil	ES17 White Cedar: Fresh-Moist, Coarse-Fine Loamy Soil	ES21 Fir-Spruce Mixedwood: Fresh, Coarse Loamy Soil	ES23 Hardwood-Fir-Spruce Mixedwood: Moist, Sandy-Coarse Loamy Soil	ES17 White Cedar: Fresh-Moist, Coarse-Fine Loamy Soil	ES37 Rich Swamp: Cedar (Other conifer): Organic Soil
V30 Jack Pine-Black Spruce/ Blueberry/Lichen	V11 Trembling Aspen-Conifer/Blueberry/ Feathermoss	V21 Cedar (inc. Mixedwood)/ Mountain Maple	V16 Balsam Fir-White Spruce Mixedwood/ Feathermoss	V6 Trembling Aspen (White Birch)-Balsam Fir/ Mountain Maple	V21 Cedar (inc. Mixedwood)/ Mountain Maple	V22 Cedar (inc. Mixedwood)/ Speckled Alder/ Sphagnum
SS2 Exremely Shallow Soil on Bedrock	SS6 Shallow-Moderately Deep/ Coarse Loamy	S3 Fresh/ Coarse Loamy	S3 Fresh/ Coarse Loamy	S8 Moist/ Coarse Loamy	S8 Moist/ Coarse Loamy	S12S Wet/Organic (Sphagnum)
Dry	Dry-Fresh	Fresh	Fresh	Moist	Moist	Wet

Site Structure and Composition



Advance Growth

Forest Stage

	Immature		Mature		Overmature	
	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)
Sb	1021	N/A	948	N/A	2177	N/A
Bf	4892	N/A	1155	N/A	2258	N/A

Seedbed

	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen
	35	35	0	21	4	35	35	0	21	4	35	35	0	21	4

Coarse Woody Debris

	Logs	Debris	Logs	Debris	Logs	Debris
	N/A	N/A	N/A	N/A	N/A	N/A

Vegetation and Soil Type Relationships

(number of plots with defined combinations)

14 Balsam Fir Mixedwood	15 White Spruce Mixedwood	16 Balsam Fir – White Spruce Mixedwood / Feathermoss	17 Jack Pine Mixedwood / Shrub Rich	18 Jack Pine Mixedwood / Feathermoss	19 Black Spruce Mixedwood / Herb Rich		
▒	□	□	▒	▒	□		
6	2	6	13	9	10	▒	S3 – Fresh / Coarse Loamy
5	4	8	11	7	8	▒	SS6 – Shallow – Moderately Deep / Coarse Loamy

Description of Soil and Vegetation

▒	Characteristic Common
■	Common Inclusions
□	Characteristic Uncommon

Selected Species Habitat Use

Species	Forest Stage Pre-sapling	 Sapling	 Immature	 Mature	 Overmature	Special Habitat Preferences
Spruce Grouse				○	○	
Great Grey Owl						
Black-backed Woodpecker				○	○	snags
Pileated Woodpecker						
Least Flycatcher						
Boreal Chickadee				○	○	snags
Swainson's Thrush			○	○	○	
Nashville Warbler		○	○	○		high level of light penetration, preferably with shallow undergrowth
Connecticut Warbler						
White-throated Sparrow	○			○	○	numerous openings with low dense vegetation
Northern Flying Squirrel				○	○	snags
Southern Red-backed Vole		○	○	●	●	downed woody debris
Meadow Vole	○					fields, grassy meadows
Marten			○	●	●	snags, downed woody debris
Woodland Caribou (winter)						
Woodland Caribou (hab. rank)				○	○	
White-tailed Deer (forage)	○	○			○	
White-tailed Deer (cover)			○	●	●	
Moose (forage)	○	○				
Moose (cover)			●	●	●	

○ Used Habitat ● Preferred Habitat

Successional Relationships - Natural

These stands are often dominated by balsam fir, white spruce and black spruce in the canopy with mixtures of trembling aspen and white birch. Balsam fir is the most frequent and abundant species and may occasionally occur as pure stands. Total tree cover remains high during much of this stands existence. This ecosite is typically shrub and herb poor. The tall and low shrub layers are usually dominated by balsam fir although white birch, trembling aspen and black spruce can also occur in the sapling layer on this ecosite. Stand age varies from 43 to 177 years with the majority of sites occurring in the 70 to 100 year range.

Tall shrubs are frequent and occur at low cover in most stands. Ericaceous shrubs are typically uncommon. The low shrub, *Diervilla lonicera*, is commonly encountered throughout the life of this stand. *Rosa acicularis* and *Ribes* spp. are common but not abundant. The herb layer is floristically rich and total cover can be quite high (>30 percent) although any one individual species cover is low. Moss species richness is also high. *Pleurozium schreberi* is the most ubiquitous and occurs at moderate cover.

In the absence of the spruce budworm, the overall successional trajectory for these stands is toward a more open, uneven-aged canopy of mixed species composition. The hardwood component is slowly replaced by coniferous species, particularly, white spruce and balsam fir. The oldest stands are uneven-aged and show strong conifer regeneration in the sub-canopy and seedling layers. The canopy cover decreases as sub-canopy cover increases. At extended rotations, white spruce will form a super-canopy with a main canopy of balsam fir, white birch and black spruce. White spruce rarely forms pure stands. Tall shrub frequency and cover (particularly *Acer spicatum* and *Corylus cornuta*) increase with age while *Vaccinium* spp. abundance decreases past 60 years of age. These stands become essentially self-regenerating. Species richness, diversity and evenness remain high in older stands on this ecosite.

Balsam fir is favored by gap creation in previous trembling aspen dominated mixedwoods. At even older ages (140 years) and in the absence of fire, sparse regeneration of the hardwood components results in an increasing dominance by woody shrubs and shade tolerant conifers such as balsam fir. The balsam fir sub-canopy component in aspen dominated stands eventually grows through into the main canopy. Species richness, diversity and evenness increase marginally over time. Mean tree species richness, diversity and evenness all increase over time, indicating the increasingly ‘mixed’ nature of the canopy-sub-canopy as stands age.

The presence of spruce budworm on the landscape is a critical component in directing succession of these balsam fir dominated ecosystems. Periodic infestations of spruce budworm can kill 70 to 100 percent of all balsam fir stems and between 10 to 40 percent of all white spruce stems in the overstorey. This is provided that defoliation extends through five or more years. Spruce budworm outbreaks tend to be self-propagating once initiated with outbreak severity positively correlated with the proportion of balsam fir in the canopy. Trees that do survive defoliation usually become weakened and are susceptible to root rot and wind-throw.

Succession following spruce budworm infestation is different than that following fire because the budworm does not usually eliminate all balsam fir stems on the site. Canopy removal releases balsam fir and white/black spruce seedlings in the understorey often favoring the spruce component. The removal of the canopy may also favor the regeneration of more shade tolerant woody tall shrubs such as *Acer spicatum* and *Corylus cornuta* which exist in the understorey. These woody shrubs often suppress or reduce any further balsam fir regeneration on the forest floor.

Successional Relationships - Post-harvest

Response following harvest:

Post-harvest successional patterns are extremely complex and difficult to predict due to the combined interaction of soil/site conditions, original stand conditions, season of harvest and severity and duration of the harvest activity. Following harvest, aspen and white birch increase in density and dominance due to rapid sprouting and suckering from any remaining stems. Removal of the overstorey results in the reproduction and growth of wood shrubs and the herbaceous layer. Balsam fir seedlings are released and new seedbeds for balsam fir are created by disturbance to the mineral floor.

The protection of conifer advance growth often will result in stand development patterns and compositions similar to that following wildfire; however, the prevalent species in the post-logging cover type is balsam fir due to lack of a spruce seed source and a sufficient quantity and quality of receptive seedbed for white and black spruce. This ecosite has a low probability of sufficient number and distribution of black spruce advance growth to form a significant component of the new stand. Careful logging techniques will result in a mixedwood stand condition where balsam fir is a significant component.

Response following harvest and mechanical site preparation:

Following harvest, aspen and white birch increase in density and dominance due to rapid sprouting and suckering. Removal of the overstorey results in the reproduction and growth of wood shrubs and the herbaceous layer. Mechanical site preparation stimulates hardwood suckering and sprouting of shrubs — especially *Corylus cornuta* by stimulating reproduction from underground sprouts. Disc trenching, blading and use of a brush blade will reduce the cover and abundance of the *Corylus cornuta* but will have minimal effect on *Acer spicatum*. However, mechanical site preparation on these sites is very effective in reducing the proportion of balsam fir in the new stand arising from advance growth present at time of harvest. Post-harvest advance regeneration of balsam fir which survives following mechanical site preparation is generally of poor quality.

Response following harvest and prescribed fire:

High intensity severe prescribed burns will effectively reduce the density and dominance of aspen and white birch in the regeneration phase as well as *Acer spicatum* and *Corylus cornuta*. Low intensity prescribed fire will stimulate the regeneration of the *Corylus cornuta* but repeat summer fires will exhaust stored food reserves and reduce its ability to re-sprout. Prescribed fire on this site generally creates exceptional seedbed conditions for a variety of grass species and wild raspberry which colonize via rhizomes and seeds. Prescribed fire of existing grass will stimulate seeding. Prescribed fire is successful in eliminating balsam fir regeneration and advance growth; the degree of impact is related to severity and intensity of the burn.

Site Productivity

Site Index by species and NWO FEC Soil Type

Site Index (breast height age 50 years)

Soil Type	Species		
	Sb	Pj	Po
S3	14.8	17.5	17.7
SS6	13.6	16.7	17.9

Black Spruce Advance Regeneration

	Vegetation Type		
	V14	V16	V19
Stocking (%)	N/A	N/A	23
Stocking Range	N/A	N/A	0 – 75
Stems per ha	N/A	N/A	1200

V14 is the characteristic vegetation type with V19 and V16 as common inclusions.

Balsam fir, white spruce, and black spruce dominate the ecosite with trembling aspen and white birch present in varying proportions.

This ecosite has a low probability of sufficient number and distribution of black spruce advance growth to regenerate the site.

The number and distribution of black spruce advance growth on this ecosite is positively related to:

- basal area of black spruce in the original stand

and inversely related to:

- percent cover of herbaceous species
- percent cover of broadleaf litter
- percent canopy closure

Natural Ingress Probability and Density (ten years post-disturbance)

Seedbed Condition	Species and Height Class					
	Sb		Pj		Po	
	< 1.0	> 1.0	< 1.0	>1.0	< 1.0	> 1.0
Duff	X ▓	X ▓	X ░	H ▒	X ░	X ▓
Mineral Soil	Insufficient Data					
Burned	Insufficient Data					

Probability Class

V- < 21%
L- 21 - 40%
M- 41 - 60%
H- 61 - 80%
X- > 80%

Density Class

░ < 300
▒ 300 - 1000
▓ 1001 - 5000
▇ 5001 - 10000
█ > 10000

Critical Comments

- Moderate woody shrub and hardwood tree competition from mountain maple, beaked hazel and balsam fir on V14, V15, V16, and V19. *Calamagrostis canadensis* is often abundant following harvest when excessive amounts of soil
- Most tree species will be highly susceptible to *Armillaria* spp. on this site. Balsam fir, white spruce and black spruce may also be susceptible to *Inonotus tomentosus* on the same sites where *Armillaria* spp. occurs.
- Stands are vulnerable to spruce budworm if the proportion of balsam fir and white spruce in the stands exceeds 20 percent of the total crown volume.
- Soil/site conditions limit the use of hexazinone products for chemical site preparation.
- Natural regeneration of black spruce and jack pine limited by available local seed supply and lack of suitable supply and duration of receptive seedbed.

Site Characteristics, Limitations and Hazard Potential

Characteristics							Limitations				Hazard Potential				
LFH Layer	Soil Texture	Depth to Bedrock	Stoniness	Moisture Regime	Terrain	Competition	Windthrow	Frost Heaving	Drought/Desiccation	Seasonal Flooding	Compaction	Rutting	Soil Erosion	Biomass & Nutrient Removal	Silvicultural Activities
	3	3	4										3		Harvesting
1	2	3	4			5	3		3				3		Renewal
	2	3				5									Tending

Footnotes:

1. LFH layer is a poor seedbed.
2. Coarse textured soils are nutrient poor.
3. Shallow soils (20 to 50 cm) susceptible to erosion, seasonal drought/desiccation, windthrow and low nutrient levels.
4. Potential for high surface stone content may limit equipment operability.
5. Moderate competition with mountain maple, beaked hazel, balsam fir and aspen as the the principle competitors.

Opportunities

- This ecosite may support, and be managed for, tolerant hardwoods in the southwestern part of region.
- This ecosite can also be managed to support forests dominated by balsam fir, white birch, and/or white spruce.
- White spruce and black spruce seed trees, combined with site preparation for mineral soil exposure, can augment conifer regeneration levels.
- Use prescribed fire after harvest to eliminate dense balsam fir advance growth and create plantable spots or stimulate aspen suckering.
- Browse production potential is high, both before and after harvest.
- This ecosite may provide winter shelter for moose depending upon the habitat mosaic.
- Stands associated with this ecosite have a high degree of structural diversity contributing to their importance as potential habitat for small mammals, furbearers and a large number of songbirds.

Silvicultural Intensity Considerations

Species Objective	Site Productivity	Degree of Effort to Reach Free-to-grow
Black spruce	1 – 2	3
Jack pine	1	3
Aspen	2	(1)*

Site Productivity - Site Productivity class (prime land productivity class) based upon height of dominant trees at age 50 years (breast height).

Degree of Effort

1 = Extensive
2 = Basic
3 = Intensive
4 = Highly Intensive

Silvicultural Interpretations for the Establishment of Black Spruce

Silvicultural System **• Harvest Method**		**Comments**
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	R	An assessment of seedbed quality and the quality and quantity of black spruce parent trees in the leave strip is necessary to determine potential of this treatment. Strip width should be less than 40 m due to soil moisture regime. This cutting technique may also be prescribed to meet other management objectives.
- Patch	R	An assessment of seedbed quality and the quality and quantity of black spruce parent trees in the leave patch is necessary to determine potential of this treatment. Careful consideration must be given to the size and configuration of patches due to soil moisture regime. This cutting technique may also be prescribed to meet other management objectives.
- Seed-tree	NR	Potential for natural seeding is very low due to infrequent occurrence of black spruce in the original stand. Potential for seasonal drought will further limit the success of this treatment.
Shelterwood	NR	Black spruce is mid-tolerant and susceptible to windthrow after thinning of closed canopy stands.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	R	
Tree-length	R	Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	R	See Tree-length comment.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Black Spruce (con't)

Renewal Treatments		Comments
Site Preparation		Moderate competition on this site.
• Mechanical	R	Techniques, timing and sequencing of treatments should be carefully considered. Chemi-mechanical site preparation should be considered. Potential for standing dead and down woody debris resulting from repeat spruce budworm infestation is high and will affect equipment operability and effectiveness.
• Chemical	R	Shrub and herb poor. Chemical site preparation is generally not required.
• Prescribed Burn	R	Severity of burn will affect vegetation response. Fire will be beneficial for reduction of balsam fir competition, standing dead and down woody debris and associated heavy slash loads.
Regeneration • Natural - Advance Growth	NR	Black spruce advance growth is not of sufficient quantity or distribution to regenerate the site.
- Seed	R	Moderate levels of black spruce ingress. May require supplemental artificial regeneration. (Note: all data obtained from V19 - Characteristic Uncommon)
- Vegetative (coppice)	NR	Black spruce does not coppice.
• Artificial - Planting	R	
- Seeding	NR	Smothering of seedbeds with hardwood litter will reduce seeding success.
- Scarification	NR	Moderate levels of black spruce ingress.
Tending Treatments		
Cleaning		Moderate competition on this site.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing is usually not necessary since black spruce natural regeneration is minimal.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine

Silvicultural System **• Harvest Method**		**Comments**
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	R	Residual stand will not contribute seed of sufficient quantity or genetic quality. However, this cutting technique may be prescribed to meet other management objectives.
- Patch	R	See Strip/Block comment.
- Seed-tree	NR	Potential for natural seeding is very low due to infrequent occurrence of jack pine in the original stand.
Shelterwood	NR	Jack pine is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	R	
Tree-length	R	Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	R	See Tree-length comment.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine (con't)

Renewal Treatments	Comments	
Site Preparation		Moderate competition on this site.
• Mechanical	R	Techniques, timing and sequencing of treatments should be carefully considered. Chemi-mechanical site preparation should be considered. Potential for standing dead and down woody debris resulting from repeat spruce budworm infestation is high and will affect equipment operability and effectiveness.
• Chemical	R	Shrub and herb poor. Chemical site preparation is generally not required.
• Prescribed Burn	R	Severity of burn will affect vegetation response. Fire will be beneficial for reduction of balsam fir competition, standing dead and down woody debris and associated heavy slash loads.
Regeneration • Natural - Advance Growth	NR	Jack pine does not regenerate under a closed canopy.
- Seed	NR	Low levels of jack pine ingress.
- Vegetative (coppice)	NR	Jack pine does not coppice.
• Artificial - Planting	R	
- Seeding	CR	Shelter seeding only. Good selection of seedbed micro-sites will contribute to success. Smothering of seedbeds with hardwood litter will limit success. The distribution, abundance and vigour of competitive non-crop vegetation will affect the survival and growth of seed origin jack pine.
- Scarification	NR	Low levels of jack pine ingress.
Tending Treatments		
Cleaning		Moderate competition on this site.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing is usually not necessary since jack pine natural regeneration is minimal.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Aspen

Silvicultural System **• Harvest Method**	**Comments**	
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	CR	Strip width should be at least 20 m to warm the soil and stimulate suckering. Strip cutting can also be prescribed to meet other management objectives.
- Patch	CR	Openings 0.4 ha in size are the minimum acceptable to stimulate aspen suckering. Patch cutting can also be prescribed to meet other management objectives.
- Seed-tree	NR	Leaving live aspen will reduce suckering.
Shelterwood	NR	Aspen is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	R	
Tree-length	R	Potential for heavy slash loadings will influence effectiveness of site preparation. Slash remaining on the site will also reduce soil temperature and suckering.
Cut-to-length/Shortwood	R	See Tree-length comment. Concentration of slash in rows by single grip harvesters will create an uneven distribution of aspen suckers.

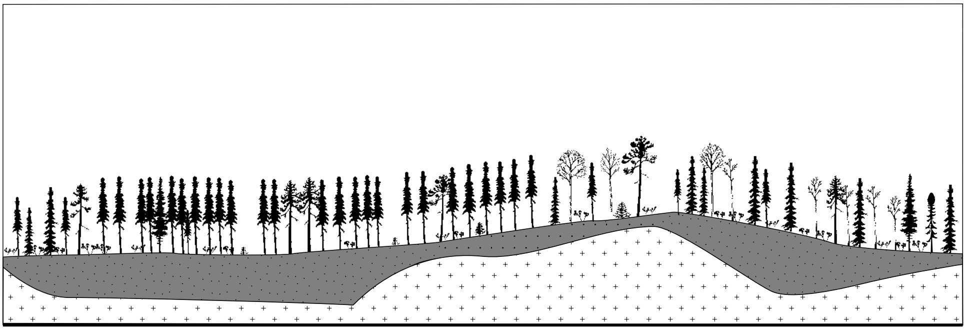
R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Aspen (con't)

Renewal Treatments	**Comments**	
Site Preparation • Mechanical	NR	See Scarification (section II, Book I).
• Chemical	R	Chemical site preparation may be used on sites where the residual overstorey will negatively affect root suckering. 2,4-D is recommended since it will remove the overstorey without damaging the aspen root systems.
• Prescribed Burn	R	
Regeneration • Natural - Advance Growth	NR	Aspen does not regenerate under a closed canopy.
- Seed	NR	Aspen regeneration from seed is highly variable.
-Vegetative (coppice)	R	There may be insufficient aspen on this site to achieve management objectives.
• Artificial - Planting	NR	Insufficient data and/or field experience exist to recommend this technique. Planting aspen seedlings may be considered when existing aspen has deteriorated to a point where vegetative regeneration is unlikely or undesirable.
- Seeding	NR	Insufficient data and/or field experience exist to recommend this technique.
- Scarification	R	There may be insufficient aspen on this site to achieve management objectives.
Tending Treatments		
Cleaning		Moderate competition on this site. High initial densities and rapid early growth of aspen suckers will ensure their successful renewal.
• Manual	NR	
• Mechanical	NR	
• Chemical - Ground	NR	
- Aerial	NR	
Spacing	R	Site quality and timing is critical for the success of this treatment.

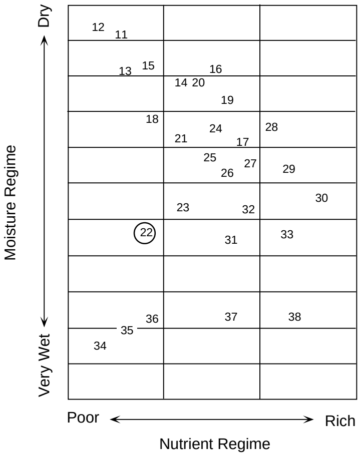
R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

ES 22 Spruce–Pine / *Ledum* / Feathermoss: Moist, Sandy–Coarse Loamy Soil



General Description

Overstory dominated by black spruce and jack pine. Trembling aspen, white birch, white spruce and balsam fir may also occur. Moderately shrub- and herb-poor. Soils moist, sandy to coarse loamy; developed predominantly on morainal, glaciofluvial and lacustrine parent material. Ground cover consists of feathermoss, conifer litter and Sphagnum.



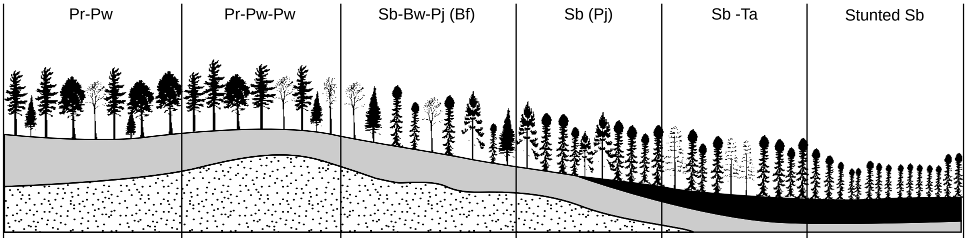
Soil Types
S7, S8, SS8
Mode of Deposition
morainal, glaciofluvial, lacustrine
Humus Form
humifibrimor, fibrimor
Overstorey
black spruce, jack pine, trembling aspen, white birch, white spruce, balsam fir
Shrubs/Trees (<10 m)
Ledum groenlandicum, black spruce, *Sorbus decora,* balsam fir, *Rosa acicularis, Gaultheria hispidula, Vaccinium myrtilloides, Vaccinium angustifolium, Linnaea borealis*
Herbs and Graminoids
Aralia nudicaulis, Equisetum sylvaticum, Coptis trifolia, Cornus canadensis, Maianthemum canadense
Mosses and Lichens
Pleurozium schreberi, Ptilium crista-castrensis, Hylocomium splendens, Dicranum polysetum, Polytrichum commune, Sphagnum capillifolium

Comments

Relatively uniform ecosite. Characteristic V-types include V33 and V34. Expect V19, V20 and V35 to occur less frequently, and rarely V37. Often associated with lower and toe slope positions. Soils may grade to very moist conditions and peaty phase (S11).

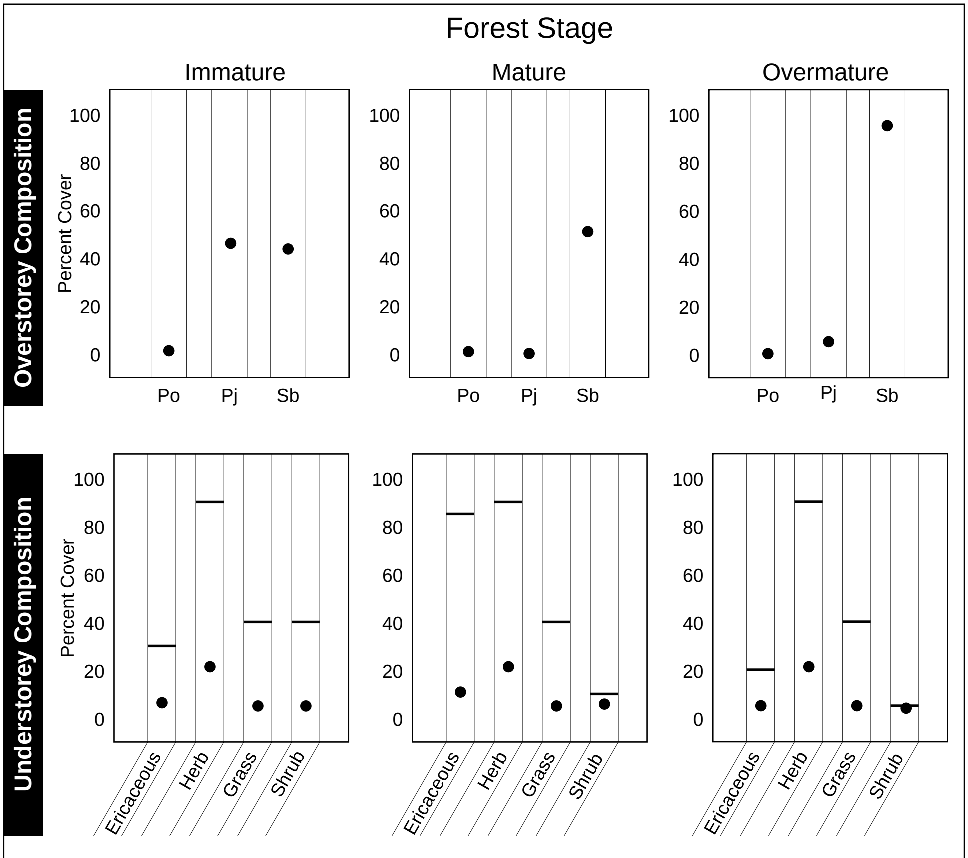
Typical Landscape Associations

Typical Ecosite Sequence on Sandy Glaciolacustrine Soil Material



ES15 Red Pine-White Pine: Sandy Soil	ES15 Red Pine-White Pine: Sandy Soil	ES14 Pine-Spruce Mixedwood: Sandy Soil	ES22 Spruce-Pine/ Ledum/ Feathermoss: Moist, Sandy-Coarse Loamy Soil	ES36 Intermediate Swamp: Black Spruce (Tamarack): Organic Soil	ES34 Treed Bog: Black Spruce/ Sphagnum: Organic Soil
V27 Red Pine Conifer	V12 White Pine Mixedwood	V18 Jack Pine Mixedwood/ Feathermoss	V33 Black Spruce/ Feathermoss	V23 Tamarack (Black Spruce)/ Speckled Alder/ Labrador-tea	V38 Black Spruce/ Leatherleaf/ Sphagnum
S1 Dry/ Coarse Sandy	S2 Fresh/ Fine Sandy	S2 Fresh/ Fine Sandy	S7 Moist/Sandy	S12F Wet/Organic (Feathermoss)	S12S Wet/Organic (Sphagnum)
Dry	Dry	Moderately Fresh	Moist	Wet	Wet

Site Structure and Composition



Advance Growth Forest Stage

	Immature		Mature		Overmature	
	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)
Sb	4252	N/A	3411	N/A	1310	N/A
Bf	872	N/A	4058	N/A	1444	N/A

Seedbed

	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen
	5	25	0	69	1	5	25	0	69	1	5	25	0	69	1

Coarse Woody Debris

	Logs	Debris	Logs	Debris	Logs	Debris
	N/A	N/A	N/A	N/A	N/A	N/A

Vegetation and Soil Type Relationships
(number of plots with defined combinations)

Black Spruce / Feathermoss 33	Black Spruce / Labrador Tea / Feathermoss (Sphagnum) 34	Black Spruce Mixedwood / Herb Rich 19	Black Spruce Mixedwood / Feathermoss 20		
▒	▒	□	□		
9	8	2	4	▒	S7 – Moist / Sandy
10	12	10	4	▒	S8 – Moist / Coarse Loamy
11	3	3	8	□	SS8 – Shallow – Moderately Deep / Mottles – Gley

Description of Soil and Vegetation

▒ Characteristic Common
■ Common Inclusions
□ Characteristic Uncommon

Selected Species Habitat Use

Species	Forest Stage					Special Habitat Preferences
	Pre-sapling	Sapling	Immature	Mature	Overmature	
Spruce Grouse			○	○	○	
Great Grey Owl				●	●	tamarack bogs preferred for nesting (use nests of other raptors)
Black-backed Woodpecker				●	●	snags
Pileated Woodpecker						
Least Flycatcher						
Boreal Chickadee				●	●	snags
Swainson's Thrush			○	○	○	
Nashville Warbler		○	○	○		high level of light penetration, preferably with shallow undergrowth
Connecticut Warbler	○	○				nests in spruce bogs/tamarack fens with well developed understorey
White-throated Sparrow	○	○			○	numerous openings with low dense vegetation
Northern Flying Squirrel				○	○	snags
Southern Red-backed Vole		○	○	●	●	downed woody debris
Meadow Vole	○					fields, grassy meadows
Marten			○	●	●	snags, downed woody debris
Woodland Caribou (winter)				○	○	arboreal lichens
Woodland Caribou (hab. rank)			●	●	●	
White-tailed Deer (forage)	○	○				
White-tailed Deer (cover)						
Moose (forage)	○	○			○	
Moose (cover)			○	○	○	

○ Used Habitat ● Preferred Habitat

Successional Relationships - Natural

This ecosite is characterized by a closed, mixed jack pine - black spruce canopy. Jack pine is almost exclusively found in the canopy, whereas black spruce is distributed throughout the canopy, sub-canopy and sapling layers. Jack pine recruitment is restricted to the first few years after fire while black spruce recruitment continues for at least 60 years post catastrophic disturbance. White birch, balsam fir, trembling aspen and/or white spruce are often present in the upper two canopies as well as in the sapling layer. Stand ages range from 45 to 186 years with the majority of sites occurring between 70 to 115 years of age.

Total shrub cover is low, and ericaceous shrubs predominate (mainly *Vaccinium* spp., *Gaultheria hispidula* and *Ledum groenlandicum*). *Ledum groenlandicum* is often present on moist sites and generally occurs at moderate to high cover. Tall shrubs are of greater importance on these ecosites. *Alnus crispa* and *Amelanchier* spp. are often found on ES22 but are usually found at low cover. Non-ericaceous shrubs and herbs occur with low frequency and/or cover. The forest floor is primarily covered by *Pleurozium schreberi* although *Dicranum polysetum* and *Ptilium crista-cristensis* are also frequent. Species richness, diversity and evenness are low compared to the other ecosites.

The successional trajectory indicates increased dominance by black spruce, in both the canopy and sub-canopy layers. Unlike ES12, black spruce recruitment into the stand remains strong and total canopy cover does not declines over time. Recruitment of black spruce is initially contemporaneous with jack pine and then becomes gradual or episodic. Episodic recruitment usually follows low-intensity surface fire. This results in a dense, uneven-aged monodominant black spruce stand.

Some relict jack pine may occur in older stands. White birch which may show moderate to strong regeneration in more open canopy sites and/or in areas of windthrow, persists in some older stands. Balsam fir regenerates well in the understorey beginning at or about 30 years of age provided a seed source is nearby. A slight increase in tree level diversity occurs at older ages reflecting the higher frequency of white birch, trembling aspen and balsam fir.

It has been speculated that mixed jack pine - black spruce stands represent a successional stage towards fir-spruce dominance. However, regional data demonstrates that although balsam fir is often present in the sapling layer it seldom enters the canopy of older stands. Differential mortality of balsam fir on this ecosite may be attributable to the combined effects of low nutrient availability, ungulate herbivory, and spruce budworm infestation.

Tall and low shrub cover will decline over time after 100 years as canopy closure is maintained. Herb cover declines steadily. Moss species continue to dominate the forest floor. The exception is *Vaccinium angustifolium* and *Linnaea borealis* which retain their presence and relatively high abundance in the low shrub layer. Total herb cover is generally less than that of shrubs and also declines, particularly in older stands.

Successional Relationships - Post-harvest

Response following harvest:

The presence of a viable black spruce or jack pine seed source from residuals or adjacent stands will contribute to the perpetuation of those species on this ecosite. Jack pine in the original stand will make the likelihood of jack pine ingress greater. An aspen component present in the original canopy is likely to be maintained through vegetative suckering while birch will be maintained through seed origin reproduction.

A moderate probability exists for black spruce advance growth to occur in the understorey in the undisturbed stand. Stocking of black spruce and balsam fir in the sub-canopy or as advance growth in the understorey will be greatly reduced following canopy removal due to exposure, sunscald and increased droughtiness of the site.

Proliferation of woody shrubs is common and the presence and cover of ericaceous shrubs in deeper soil pockets will be enhanced. Exposed feathermoss quickly dies following removal of the overstorey.

Response following harvest and mechanical site preparation:

Disturbance and mixing of the LFH with mineral soil will create suitable seedbed for black spruce and jack pine. If jack pine is present in the original stand, its presence in the future stand may be enhanced by scarification on the site.

Soil disturbance will stimulate the establishment and growth of woody shrubs and will stimulate hardwood suckering especially from aspen. Buried branch parts will root and revegetate new plants. Ericaceous shrubs will increase in abundance by sprouting from rhizomes. Mechanical site preparation and the exposure or mixing or mineral and organic soils will stimulate the establishment of grasses and wild raspberry. Retention of an intact forest floor condition will reduce non-crop species on site.

Response following harvest and prescribed fire:

Following fire, the growth of ericaceous shrubs (blueberry) and herbs (fireweed) is stimulated. These species can quickly dominate the site within two years. Moderate to high intensity surface fires will be effective in reducing future competition from woody shrubs and exposing a mineral soil seedbed suitable for conifer establishment. Prescribed fire will destroy any black spruce or balsam fir advance growth and will usually girdle any seedling jack pine. Moderate to severe intensity surface fires will completely remove the surface organic horizons and kill any hardwood shrubs or aspen present on the cutover.

Ericaceous shrubs will sprout following light intensity fires but sprouting is suppressed by high intensity, severe fires.

Site Productivity

Site Index by species and NWO FEC Soil Type

Site Index (breast height age 50 years)

Soil Type	Species		
	Sb	Pj	Po
S7	15.1	18.8	16.0
S8	13.0	16.6	19.4
SS8	15.3	16.8	17.2

Black Spruce Advance Regeneration

	Vegetation Type	
	V33	V34
Stocking (%)	24	40
Stocking Range	0 – 95	0 – 90
Stems per ha	2500	3100

V33 is the characteristic vegetation type with V34 as a common inclusion.

This ecosite is dominated by black spruce and jack pine with scattered stems of other species.

Where black spruce dominates the original stand, there is a moderate possibility of advance growth being present in numbers and distribution to regenerate the site.

The number and distribution of black spruce advance growth on this ecosite is positively related to:

- basal area of black spruce in the original stand
- percent cover of sphagnum moss or Labrador-tea

and inversely related to:

- percent cover of herbaceous species
- percent cover of broadleaf litter
- percent canopy closure

Natural Ingress Probability and Density (ten years post-disturbance)

Information not available

Critical Comments

- Woody shrub competition from speckled alder can be expected on lower slope positions and seepage areas.
- Abundance of wild red raspberry and *Calamagrostis candensis* should be expected following harvest and disturbance of the surface organic layer.
- Black spruce growing on moist to very moist sandy soils are prone to windthrow after openings are created in the canopy. Windthrow hazard is further enhanced by high stone content near the surface on morainal soils.
- Jack pine subject to early stand breakup associated with the increased occurrence of butt and heart rot associated with the moist sandy-coarse loamy soils.
- Black spruce on moist, poorly drained sites are highly susceptible to spruce budworm.

Site Characteristics, Limitations and Hazard Potential

Characteristics							Limitations				Hazard Potential				
LFH Layer	Soil Texture	Depth to Bedrock	Stoniness	Moisture Regime	Terrain	Competition	Windthrow	Frost Heaving	Drought/Desiccation	Seasonal Flooding	Compaction	Rutting	Soil Erosion	Biomass & Nutrient Removal	Silvicultural Activities
	2		3												Harvesting
1	2		3	4		4									Renewal
	2			4		4									Tending

Footnotes:

1. LFH layer is a poor seedbed.
2. Coarse textured soils are nutrient poor.
3. Potential for high surface stone content may limit equipment operability.
4. Disturbance of the forest floor on moist soils will promote non-crop vegetation.

Opportunities

- Careful logging to preserve black spruce advance growth, combined with moderate levels of black spruce ingress, is an effective lower cost regeneration strategy.
- The retention of seed-producing black and white spruce trees during harvest will contribute to natural regeneration levels. Some forest floor disturbance necessary.
- Planting red and white pine on moist sites is possible.
- Prescribed fire can be employed after harvest to eliminate dense balsam fir advance growth and create plantable spots.
- Cone scattering of jack pine slash with light site preparation is an option under certain site and stand conditions.
- On sandy phase of this site, broadcast or precision seeding of jack pine on mineral soil seedbeds is highly successful.
- Jack pine and black spruce seed trees (minimum 20/ha) in conjunction with prescribed fire offers a cost-effective regeneration strategy on these sites. Target the less competitive sites for this treatment.

Silvicultural Intensity Considerations

Species Objective	Site Productivity	Degree of Effort to Reach Free-to-grow
Black spruce	1	1
Jack pine	2	1
Aspen	2	(1)*

Site Productivity - Site Productivity class (prime land productivity class) based upon height of dominant trees at age 50 years (breast height).

Degree of Effort

1 = Extensive
2 = Basic
3 = Intensive
4 = Highly Intensive

Silvicultural Interpretations for the Establishment of Black Spruce

Silvicultural System **• Harvest Method**		**Comments**
Clearcut • Harvest Method - Conventional	R	
- Strip	R	An assessment of seedbed quality and the quality and quantity of black spruce parent trees in the leave strip is necessary to determine potential of this treatment. Strip width should be less than 40 m due to soil moisture regime. This cutting technique may also be prescribed to meet other management objectives.
- Patch	R	An assessment of seedbed quality and the quality and quantity of black spruce parent trees in the leave patch is necessary to determine potential of this treatment. Careful consideration must be given to the size and configuration of patches due to soil moisture regime. This cutting technique may also be prescribed to meet other management objectives.
- Seed-tree	R	Group seed tree is the most commonly used technique. Individual seed tree to be used only in conjunction with prescribed fire. Ensure there is adequate distribution of black spruce in the portion of the stand where seed tree system is being prescribed.
Shelterwood	NR	Black spruce is mid-tolerant and susceptible to windthrow after thinning of closed canopy stands.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	R	
Tree-length	R	Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	R	See Tree-length comment.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Black Spruce (con't)

Renewal Treatments	Comments	
Site Preparation		Low competition on this site. Trembling aspen may be locally abundant.
• Mechanical	R	Techniques, timing and sequencing of treatments should be carefully considered to inhibit establishment of non-crop vegetation.
• Chemical	R	Shrub and herb poor. Chemical site preparation is generally not required.
• Prescribed Burn	R	Severity of burn will affect vegetation response.
Regeneration • Natural - Advance Growth	R	Moderate levels of advance growth. May require supplemental artificial regeneration.
- Seed	R	Insufficient data exist. Site conditions imply moderate levels of black spruce ingress. May require supplemental artificial regeneration.
- Vegetative (coppice)	NR	Black spruce does not coppice.
• Artificial - Planting	R	
- Seeding	R	Potential for aerial seeding is moderate. An abundant supply of seed from slash is necessary to supplement the aerial seeding. Site preparation is required to create sufficient suitable seedbed.
- Scarification	NR	Insufficient data exist. Site conditions imply moderate levels of black spruce ingress.
Tending Treatments		
Cleaning		Generally low competition on this site and cleaning is usually not required.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing will be beneficial where black spruce density is high from seeding or advance growth.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine

Silvicultural System **• Harvest Method**		**Comments**
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	R	Residual stand will not contribute seed of sufficient quantity or genetic quality. However, this cutting technique may be prescribed to meet other management objectives.
- Patch	R	See Strip/Block comment.
- Seed-tree	CR	Jack pine seed tree systems are only to be used in conjunction with a post-harvest prescribed burn which creates 50% net mineral soil exposure well distributed across the site.
Shelterwood	NR	Jack pine is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	R	
Tree-length	R	Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	R	See Tree-length comment.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine (con't)

Renewal Treatments		Comments
Site Preparation		Low competition on this site. Aspen may be locally abundant.
• Mechanical	R	Techniques, timing and sequencing of treatments should be carefully considered to inhibit establishment of non-crop vegetation.
• Chemical	R	Shrub and herb poor. Chemical site preparation is generally not required.
• Prescribed Burn	R	Severity of burn will affect vegetation response. Prescribed burning is required when using seed tree silvicultural system.
Regeneration • Natural - Advance Growth	NR	Jack pine does not regenerate under a closed canopy.
- Seed	NR	Insufficient data exist. Site conditions imply low to moderate levels of jack pine ingress.
- Vegetative (coppice)	NR	Jack pine does not coppice.
• Artificial - Planting	R	
- Seeding	R	Good distribution of mineral soil seedbeds will contribute to success.
- Scarification	NR	Insufficient data exist. Site conditions imply low to moderate levels of jack pine ingress.
Tending Treatments		
Cleaning		Low competition on this site and cleaning is generally not required.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing is usually not necessary since jack pine natural regeneration is minimal.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Aspen

Silvicultural System **• Harvest Method**	**Comments**	
Clearcut		
• Harvest Method		
- Conventional	R	
- Strip/Block	CR	Strip width should be less than 20 m to warm the soil and stimulate suckering. Strip cutting can also be prescribed to meet other management objectives.
- Patch	CR	Openings 0.4 ha in size are the minimum acceptable to stimulate aspen suckering. Patch cutting can also be prescribed to meet other management objectives.
- Seed-tree	NR	Leaving live aspen will reduce suckering.
Shelterwood	NR	Aspen is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	R	
Tree-length	R	Potential for heavy slash loadings will influence effectiveness of site preparation. Slash remaining on the site will also reduce soil temperature and suckering.
Cut-to-length/Shortwood	R	See Tree-length comment. Concentration of slash in rows by single grip harvesters will create an uneven distribution of aspen suckers.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

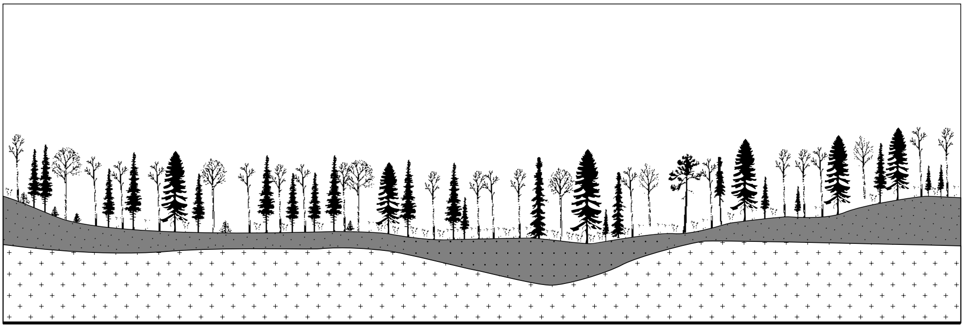
Silvicultural Interpretations for the Establishment of Aspen (con't)

Renewal Treatments	Comments	
Site Preparation • Mechanical	NR	See Scarification (Section II, Book I).
• Chemical	R	Chemical site preparation may be used on sites where the residual overstorey will negatively affect root suckering. 2,4-D is recommended since it will remove the overstorey without damaging the aspen root systems.
• Prescribed Burn	R	
Regeneration • Natural - Advance Growth	NR	Aspen does not regenerate under a closed canopy.
- Seed	NR	Aspen regeneration from seed is highly variable.
- Vegetative (coppice)	R	There may be insufficient aspen on this site to achieve management objectives.
• Artificial - Planting	NR	Insufficient data and/or field experience exist to recommend this technique. Planting of aspen seedlings may be considered when existing aspen has deteriorated to a point where vegetative regeneration is unlikely or undesirable.
- Seeding	NR	Insufficient data and/or field experience exist to recommend this technique.
- Scarification	R	There may be insufficient aspen on this site to achieve management objectives.
Tending Treatments		
Cleaning		Low competition on this site. High initial densities and rapid early growth of aspen suckers will ensure their successful renewal.
• Manual	NR	.
• Mechanical	NR	
• Chemical - Ground	NR	
- Aerial	NR	
Spacing	R	Site quality and timing is critical for the success of this treatment.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

ES 23

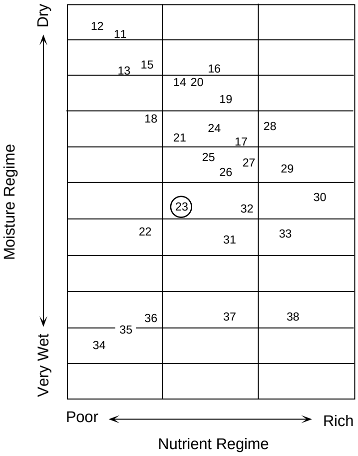
Hardwood–Fir–Spruce Mixedwood: Moist, Sandy–Coarse Loamy Soil



approximately 250 m

General Description

Dominated by trembling aspen, white birch, balsam fir and occasional occurrence of white spruce, black spruce and jack pine. Deciduous tree component exceeds 50% of the canopy. Moderately shrub- and herb-rich. Soils are moist, sandy to coarse loamy. Occurring predominantly on morainal, glaciofluvial and occasionally lacustrine parent material. Ground cover consists of broadleaf litter, conifer litter, feathermoss and occasional patches of Sphagnum.



Soil Types
S7, S8, SS8

Mode of Deposition
morainal, glaciofluvial

Humus Form
humifibrimor, fibrimor

Overstorey
white birch, trembling aspen, balsam fir, white spruce, black spruce, jack pine, balsam poplar

Shrubs/Trees (<10 m)
Acer spicatum, Corylus cornuta, Rubus pubescens, Sorbus decora, Linnaea borealis, balsam fir, trembling aspen

Herbs and Graminoids
Aster macrophyllus, Streptopus roseus, Aralia nudicaulis, Viola renifolia, Galium triflorum, Clintonia borealis, Trientalis borealis, Maianthemum canadense, Cornus canadensis

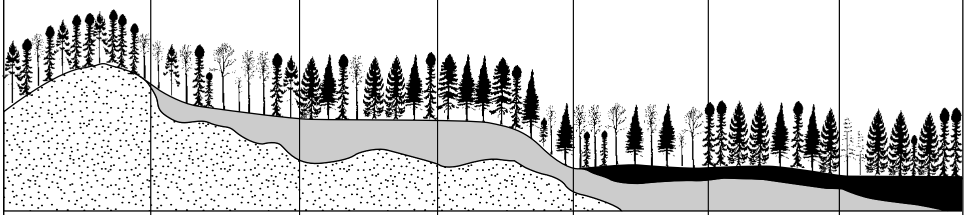
Mosses and Lichens
Pleurozium schreberi, Ptilium crista-castrensis

Comments

This ecosite typically occurs on lower slopes in rolling terrain. Characteristic V-types include V1, V5, V6, V7, V8 and V9 but expect to see V14 and V19 in patches. Often associated with lower and toe slope positions. May contain tolerant hardwoods such as yellow birch and red maple in Site Regions 4S, 4W and 5S.

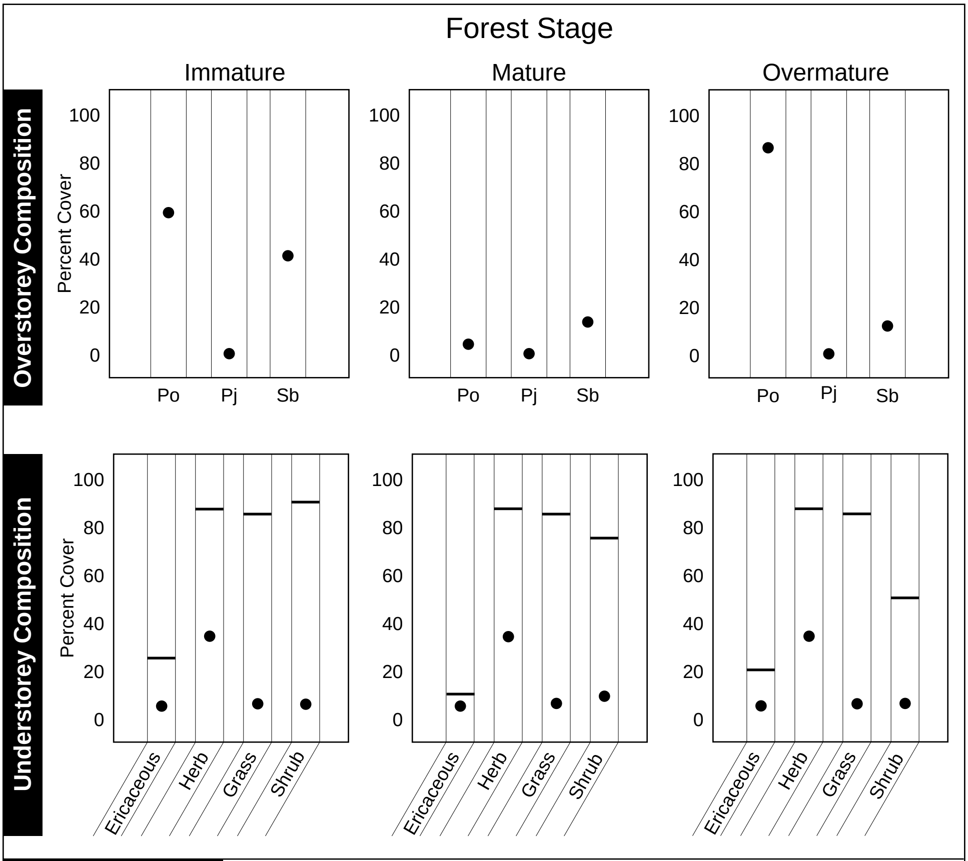
Typical Landscape Associations

Typical Ecosite Sequence on Very Shallow to Deep Coarse Loamy Till Material



Sb-Pj (Po)	Po-Sb-Pj (Bw)	Ce-Bf (Sb-Po)	Bf-Sw (Po-Sb)	Po-Bf-Bw (Sb)	Ce-Sb (Bf)	Ce-Sb (Ta)
ES12 Black Spruce-Jack Pine: Very Shallow Soil	ES19 Hardwood-Fir-Spruce Mixedwood: Fresh, Sandy-Coarse Loamy Soil	ES17 White Cedar: Fresh-Moist, Coarse-Fine Loamy Soil	ES21 Fir-Spruce Mixedwood: Fresh, Coarse Loamy Soil	ES23 Hardwood-Fir-Spruce Mixedwood: Moist, Sandy-Coarse Loamy Soil	ES17 White Cedar: Fresh-Moist, Coarse-Fine Loamy Soil	ES37 Rich Swamp: Cedar (Other conifer): Organic Soil
V30 Jack Pine-Black Spruce/ Blueberry/Lichen	V11 Trembling Aspen-Conifer/Blueberry/ Feathermoss	V21 Cedar (inc. Mixedwood)/ Mountain Maple	V16 Balsam Fir-White Spruce Mixedwood/ Feathermoss	V6 Trembling Aspen (White Birch)-Balsam Fir/ Mountain Maple	V21 Cedar (inc. Mixedwood)/ Mountain Maple	V22 Cedar (inc. Mixedwood)/ Speckled Alder/ Sphagnum
SS2 Exremely Shallow Soil on Bedrock	SS6 Shallow-Moderately Deep/ Coarse Loamy	S3 Fresh/ Coarse Loamy	S3 Fresh/ Coarse Loamy	S8 Moist/ Coarse Loamy	S8 Moist/ Coarse Loamy	S12S Wet/Organic (Sphagnum)
Dry	Dry-Fresh	Fresh	Fresh	Moist	Moist	Wet

Site Structure and Composition



Advance Growth	Forest Stage					
	Immature		Mature		Overmature	
	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)
Sb	0	N/A	633	N/A	4309	N/A
Bf	3613	N/A	601	N/A	857	N/A

Seedbed

	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen
	0	9	84	7	0	0	9	84	7	0	0	9	84	7	0

Coarse Woody Debris

	Logs	Debris	Logs	Debris	Logs	Debris
	N/A	N/A	N/A	N/A	N/A	N/A

Vegetation and Soil Type Relationships

(number of plots with defined combinations)

Balsam Poplar Hardwood and Mixedwood	Aspen Hardwood	Trembling Aspen (White Birch) – Balsam Fir / Mountain Maple	Trembling Aspen – Balsam Fir / Balsam Fir Shrub	Trembling Aspen (White Birch) / Mountain Maple	Trembling Aspen Mixedwood	Balsam Fir Mixedwood		
1	5	6	7	8	9	14		
■	▒	▒	□	□	□	■		
1	5	3	2	2	1	6	▒	S7 – Moist / Sandy
5	4	2	1	1	3	1	▒	S8 – Moist / Coarse Loamy
1	1	1		2	2	1	□	SS8 – Shallow – Moderately Deep / Mottles – Gley

Description of Soil and Vegetation

▒ Characteristic Common
■ Common Inclusions
□ Characteristic Uncommon

Selected Species Habitat Use

Species	Forest Stage					Special Habitat Preferences
	Pre-sapling	Sapling	Immature	Mature	Overmature	
Spruce Grouse						
Great Grey Owl				○	○	tamarack bogs preferred for nesting (use nests of other raptors)
Black-backed Woodpecker				○	○	snags
Pileated Woodpecker				●	●	snags, downed woody debris
Least Flycatcher				●	●	often found near open spaces (edge, riparian)
Boreal Chickadee				○	○	snags
Swainson's Thrush			●	●	●	
Nashville Warbler		●	●	●		high level of light penetration, preferably with shallow undergrowth
Connecticut Warbler						
White-throated Sparrow	○	○			○	numerous openings with low dense vegetation
Northern Flying Squirrel				○	○	snags
Southern Red-backed Vole		○	○	○	○	downed woody debris
Meadow Vole	○					fields, grassy meadows
Marten			○	○	○	snags, downed woody debris
Woodland Caribou (winter)						
Woodland Caribou (hab. rank)				○	○	
White-tailed Deer (forage)	○	○			○	
White-tailed Deer (cover)			○	○	○	
Moose (forage)	○	○	○	○	○	
Moose (cover)			○	○	○	

○ Used Habitat ● Preferred Habitat

Successional Relationships - Natural

These stands are often dominated by trembling aspen in the canopy. Pure upper canopies of hardwood are possible, but white spruce, balsam fir, black spruce and/or the other hardwood are occasional codominants. Total tree cover remains high during much of this stands existence. The tall and low shrub layers are usually dominated by balsam fir although white birch and black spruce can also occur. Stand age varies from 40 to 167 years with the majority of sites occurring in the 40 to 100 year range.

The tall and low shrub layers beneath an aspen dominated stand are often dominated by *Acer spicatum* and *Corylus cornuta*; *Diervilla lonicera* is present in the low shrub layer at high cover. Tall shrubs are frequent and occur at moderate cover in most stands. The herb layer is floristically rich and herb cover is high. *Aster macrophyllus*, *Rubus pubsecens* and *Aralia nudicaulis* are the most abundant herbs. Other moisture-loving species such as *Mitella nuda*, *Coptis trifolia* and *Athyrium filix-femina* also are common on ES23 with high cover. Mosses remain a minor component in the understorey.

In the absence of the spruce budworm, the overall successional trajectory for these stands is toward a more open, multi-tiered and uneven-aged canopy of mixed species composition. By age 35 years, the spruce component of the mixedwood steadily increases to approximately 1800 stems per hectare, provided that a spruce seed source is available. By age 85 years, spruce will constitute up to 15 percent of the dominant/codominant stems. Hardwood canopy cover increases up to age 60 years on this ecosite years and then begins to decline as the intolerant hardwoods begin to ‘fall out’ of the canopy due to pathological problems. The hardwood component is slowly replaced by coniferous species, particularly, white spruce and balsam fir. The oldest stands are uneven-aged and show strong conifer regeneration in the sub-canopy and seedling layers. Residual aspen stems from the original stand may persist for 200 years or more on moist sites. White birch persists in the sub-canopy of some stands - the result of light, surface fires beneath the main canopy. At extended rotations, white spruce will form a super-canopy with a main canopy of balsam fir, white birch and black spruce.

Black spruce may be favored by gap creation created through stand breakup of the white birch dominated mixedwoods. Likewise, balsam fir is favored by gap creation in trembling aspen dominated mixedwoods. At even older ages (140 years) and in the absence of fire, sparse regeneration of the hardwood components results in an increasing dominance by woody shrubs such as *Acer spicatum* and shade tolerant conifers such as balsam fir. The balsam fir sub-canopy component in aspen dominated stands eventually grows through into the main canopy; in contrast, it is black spruce which dominates in the older birch mixedwoods. Species richness, diversity and evenness increase marginally over time. Mean tree species richness, diversity and evenness all increase over time, indicating the increasingly ‘mixed’ nature of the canopy-sub-canopy as stands age.

The cover of tall shrubs and *Diervilla lonicera* generally declines with increasing age whereas *Vaccinium* spp. increases in abundance and distribution. Suckering by trembling aspen is common, but these individuals seldom enter the sub-canopy. Herb cover declines after 100 years reflecting the increase in canopy cover by conifers and the associated change in light conditions and the geochemistry of the forest floor.

Successional Relationships - Post-harvest

Response following harvest:

Post-harvest successional patterns are extremely complex to predict due to the combined interaction of soil/site conditions, original stand conditions, season of harvest and severity and duration of the harvest activity. Following harvest, aspen and white birch increase in density and dominance due to rapid sprouting and suckering. Removal of the overstorey results in the reproduction and growth of wood shrubs and the herbaceous layer. This site is slightly more moist and rich than ecosite 16 and the vigor of woody shrub re-growth is enhanced.

The protection of conifer advance growth often will result in stand development patterns and compositions similar to that following wildfire; however, the prevalent species in the post-logging cover type is balsam fir due to lack of a spruce seed source and a sufficient quantity and quality of receptive seedbed for white and black spruce. This ecosite has a low probability of sufficient number and distribution of black spruce advance growth to form a significant component of the new stand. Careful logging techniques will result in a mixed wood stand condition where balsam fir is a significant component.

Response following harvest and mechanical site preparation:

Following harvest, aspen and white birch increase in density and dominance due to rapid sprouting and suckering. Removal of the overstorey results in the reproduction and growth of wood shrubs and the herbaceous layer. Mechanical site preparation stimulates hardwood suckering and sprouting of shrubs - especially *Corylus cornuta* by stimulating reproduction from underground sprouts. Disc trenching, blading and use of a brush blade will reduce the cover and abundance of the *Corylus cornuta* but will have minimal effect on *Acer spicatum*. The cover by herbs also increases. However, mechanical site preparation on these sites is very effective in reducing the proportion of balsam fir in the new stand arising from advance growth present at time of harvest. Post-harvest advance regeneration of balsam fir which survives following mechanical site preparation is generally of poor quality. Overall, mechanical site preparation will create a successional shift to favor hardwoods.

Response following harvest and prescribed fire:

High intensity severe prescribed burns will effectively reduce the density and dominance of aspen and white birch in the regeneration phase as well as *Acer spicatum* and *Corylus cornuta*. Low intensity prescribed fire will stimulate the regeneration of the *Corylus cornuta* but repeat summer fires will exhaust stored food reserves and reduce its ability to re-sprout. Prescribed fire is successful in eliminating balsam fir regeneration and advance growth; the degree of impact is related to severity and intensity of the burn.

Site Productivity

Site Index by species and NWO FEC Soil Type
Site Index (breast height age 50 years)

Soil Type	Species		
	Sb	Pj	Po
S7	15.1	18.8	16.0
S8	13.0	16.6	19.4
SS8	15.3	16.8	17.2

Black Spruce Advance Regeneration

	Vegetation Type			
	V6	V7	V8	V9
Stocking (%)	N/A	N/A	3	10
Stocking Range	N/A	N/A	0 – 6	0 – 25
Stems per ha	N/A	N/A	100	900

No one vegetation type dominates this ecosite. V6, V7, V8 and V9 are all common inclusions.

Trembling aspen, white birch and balsam fir dominate the ecosite.

This ecosite has a low probability of sufficient number and distribution of black spruce advance growth to regenerate the site.

The number and distribution of black spruce advance growth on this ecosite is positively related to:

- basal area of black spruce in the original stand

and inversely related to:

- percent cover of herbaceous species
- percent cover of broadleaf litter
- percent canopy closure

Natural Ingress Probability and Density (ten years post-disturbance)

No information available

Critical Comments

- Occasional large quantities of decadent trembling aspen may occur dependant upon aspen clonal properties and soil moisture regime.
- Heavy woody shrub and hardwood tree competition from mountain maple, green and speckled alder, beaked hazel and balsam fir should be expected. *Calamagrostis canadensis* is often abundant following harvest when excessive amounts of soil are disturbed.
- Most tree species will be highly susceptible to *Armillaria* spp. on this site. Balsam fir, white spruce and black spruce may also be susceptible to *Inonotus tomentosus* on the same sites where *Armillaria* spp. occurs.
- Stands are vulnerable to spruce budworm if the proportion of balsam fir and white spruce in the stands exceeds 20 percent of the total crown volume.
- Soil/site conditions limit the use of hexazinone products for chemical site preparation.
- Natural regeneration of black spruce and jack pine limited by available local seed supply and lack of suitable supply and duration of receptive seedbed.
- Natural regeneration heavily dominated by balsam fir.
- Extensive slash resulting from, dead and dying balsam fir, residual balsam fir and balsam fir advance growth will limit the effectiveness of intermittent patch scarifiers and passive disc-trenchers.

Site Characteristics, Limitations and Hazard Potential

Characteristics							Limitations				Hazard Potential				
LFH Layer	Soil Texture	Depth to Bedrock	Stoniness	Moisture Regime	Terrain	Competition	Windthrow	Frost Heaving	Drought/Desiccation	Seasonal Flooding	Compaction	Rutting	Soil Erosion	Biomass & Nutrient Removal	Silvicultural Activities
	1		2	4	3	5					6	6			Harvesting
	1		2	4	3	4,5	3				6	6			Renewal
	1					5									Tending

Footnotes:

1. Coarse textured soils are nutrient poor.
2. Potential for high surface stone content may limit equipment operability.
3. This ecosite is associated with lower and toe slope positions and usually has a high water table.
4. Disturbance of the forest floor on moist soils will promote competitors.
5. High to very high competition with mountain maple, beaked hazel, balsam fir and aspen as the principle competitors.
6. Repeated mechanical traffic during periods of high seasonal water table may result in mixing of the mineral and organic horizons.

Opportunities

- This ecosite is productive for all major tree species.
- This ecosite may support, and be managed for, tolerant hardwoods in southwestern part of Region.
- Low levels of natural conifer regeneration, combined with high competition levels, make planting of large stock the preferred option for maintaining a significant conifer component on this ecosite.
- Option to selectively harvest and underplant white spruce.
- Can use prescribed fire after harvest to eliminate dense balsam fir advance growth and create plantable spots. Expect a high component of balsam fir in next forest if site is mechanical site prepared.
- Value as cover for moose habitat is low in the hardwood dominated condition but increases as conifer composition in the understorey increases.
- Potential browse production is high in both pre- and post-harvest conditions.
- Importance as habitat for pine marten and fisher will increase with stand's age, conifer composition, number of snags and structural diversity.

Silvicultural Intensity Considerations

Species Objective	Site Productivity	Degree of Effort to Reach Free-to-grow
Black spruce	1	2 – 3
Jack pine	2	2 – 3
Aspen	2	1

Degree of Effort

1 = Extensive
2 = Basic
3 = Intensive
4 = Highly Intensive

Site Productivity - Site Productivity class (prime land productivity class) based upon height of dominant trees at age 50 years (breast height).

Silvicultural Interpretations for the Establishment of Black Spruce

Silvicultural System **• Harvest Method**		**Comments**
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	R	Generally, the residual stand will not contribute seed of sufficient quantity. However, this cutting technique may be prescribed to meet other management objectives.
- Patch	R	See Strip/Block comment.
- Seed-tree	NR	Potential for natural seeding is very low due to low density of black spruce in the original stand.
Shelterwood	NR	Black spruce is mid-tolerant and susceptible to windthrow after thinning of closed canopy stands.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	R	
Tree-length	R	Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	R	See Tree-length comment.
Renewal Treatments		
Site Preparation		High to very high competition on this site.
• Mechanical	R	Techniques, timing and sequencing of treatments should be carefully considered to inhibit establishment of non-crop vegetation. Chemi-mechanical site preparation should be considered. Fire will be beneficial for reduction of standing dead and down woody debris and associated heavy slash loads.
• Chemical	R	Some herbicide-resistant non-crop species may occur on this site.
• Prescribed Burn	R	Severity of burn will affect vegetation response. Fire will be beneficial for reduction of balsam fir competition, standing dead and down woody debris and associated heavy slash loads.

Silvicultural Interpretations for the Establishment of Black Spruce (con't)

Renewal Treatments	Comments	
Regeneration • Natural - Advance Growth	NR	Black spruce advance growth is not of sufficient quantity or distribution to regenerate the site.
- Seed	NR	Insufficient data exist. Site conditions imply very low levels of black spruce ingress.
- Vegetative (coppice)	NR	Black spruce does not coppice.
• Artificial - Planting	R	
- Seeding	NR	Smothering of seedbeds with hardwood litter will limit success. In addition, the distribution, abundance and vigour of non-crop vegetation will preclude the survival and growth of seed origin black spruce.
- Scarification	NR	Insufficient data exist. Site conditions imply very low levels of black spruce ingress.
Tending Treatments		
Cleaning		High to very high competition on this site.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing is usually not necessary since black spruce natural regeneration is minimal.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine

Silvicultural System • Harvest Method		Comments
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	R	Residual stand will not contribute seed of sufficient quantity or genetic quality. However, this cutting technique may be prescribed to meet other management objectives.
- Patch	R	See Strip/Block comment.
- Seed-tree	NR	Potential for natural seeding is very low due to infrequent occurrence of jack pine in the original stand.
Shelterwood	NR	Jack pine is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	R	
Tree-length	R	Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	R	See Tree-length comment.
Renewal Treatments		
Site Preparation		High to very high competition on this site.
• Mechanical	R	Techniques, timing and sequencing of treatments should be carefully considered to inhibit establishment of non-crop vegetation. Chemi-mechanical site preparation should be considered. Potential for standing dead and down woody debris resulting from repeat spruce budworm infestation is high and will affect equipment operability and effectiveness.
• Chemical	R	Some herbicide-resistant non-crop species may occur on this site. Target species will include aspen, mountain maple and beaked hazel.
• Prescribed Burn	R	Severity of burn will affect vegetation response. Fire will be beneficial for reduction of balsam fir competition, standing dead and down woody debris and associated heavy slash loads.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine (con't)

Renewal Treatments	Comments	
Regeneration • Natural - Advance Growth	NR	Jack pine does not regenerate under a closed canopy.
- Seed	NR	Potential for natural seeding is very low due to infrequent occurrence of jack pine in the original stand.
- Vegetative (coppice)	NR	Jack pine does not coppice.
• Artificial - Planting	R	
- Seeding	NR	Smothering of seedbeds with hardwood litter will limit success. In addition, the distribution, abundance and vigour of non-crop vegetation precludes the survival and growth of seed origin jack pine.
- Scarification	NR	Cone loading is low due to low density of jack pine in the original stand. Cone scattering will give variable results.
Logging Method		
Cleaning		High to very high competition on this site.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing is usually not necessary since jack pine natural regeneration is minimal.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Aspen

Silvicultural System **• Harvest Method**		**Comments**
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	R	Strips should be at least 20 m wide to warm the soil and stimulate suckering. Strip cutting can also be prescribed to meet other management objectives.
- Patch	R	Openings 0.4 ha in size are the minimum acceptable to stimulate aspen suckering. Patch cutting can also be prescribed to meet other management objectives.
- Seed-tree	NR	Leaving live aspen will reduce suckering.
Shelterwood	NR	Aspen is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	R	
Tree-length	R	Potential for heavy slash loadings will influence effectiveness of site preparation. Slash remaining on the site will also reduce soil temperature and sucker production.
Cut-to-length/Shortwood	R	See Tree-length comment. Concentration of slash in rows by single grip harvesters will create an uneven distribution of aspen suckers.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

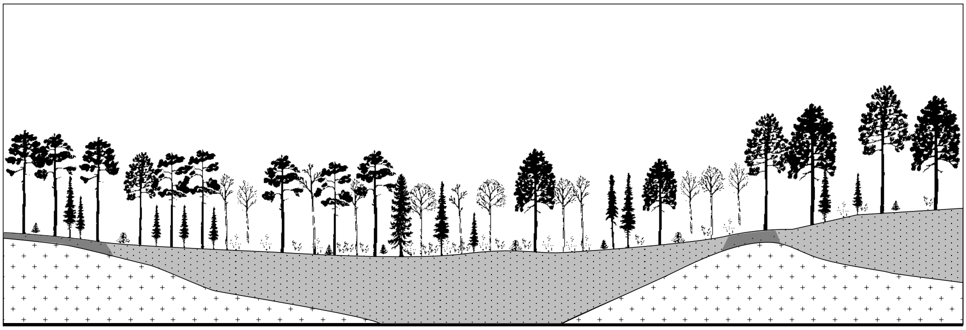
Silvicultural Interpretations for the Establishment of Aspen (con't)

Renewal Treatments	Comments	
Site Preparation • Mechanical	NR	See Scarification (Section II, Book I).
• Chemical	R	Chemical site preparation may be used on sites where the residual overstorey will negatively affect root suckering. 2,4-D is recommended since it will remove the overstorey without damaging the aspen root systems.
• Prescribed Burn	R	
Regeneration • Natural - Advance Growth	NR	Aspen does not regenerate under a closed canopy.
- Seed	NR	Aspen regeneration from seed is highly variable.
- Vegetative (coppice)	R	
• Artificial - Planting	NR	Insufficient data and/or field experience exist to recommend this technique. Planting of aspen seedlings may be considered when existing aspen has deteriorated to a point where vegetative regeneration is unlikely or undesirable.
- Seeding	NR	Insufficient data and/or field experience exist to recommend this technique.
- Scarification	R	
Tending Treatments		
Cleaning		High to very high competition on this site. High initial densities and rapid early growth of aspen suckers will ensure their successful renewal.
• Manual	NR	
• Mechanical	NR	
• Chemical - Ground	NR	
- Aerial	NR	
Spacing	R	Site quality and timing is critical for the success of this treatment.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

ES 24

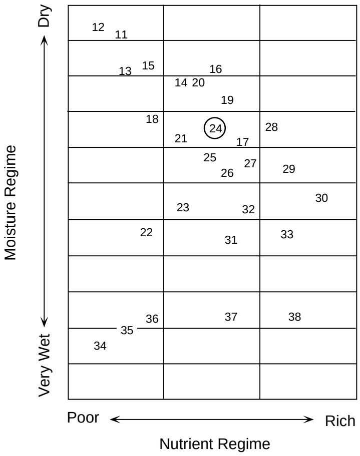
Red Pine–White Pine: Fresh, Fine Loamy Soil



approximately 250 m

General Description

Conifer dominated mixed stands with red pine, white pine and white birch. Occasionally with balsam fir and black spruce. Shrub- and herb-rich, including Acer spicatum, Corylus cornuta and Aster macrophyllus. Soils fresh, well drained, fine loamy. Occurring on lacustrine and glaciofluvial parent materials. Ground cover consists of conifer litter, hardwood litter, feathermoss and wood.



Soil Types

S4, SS7, S5

Mode of Deposition

lacustrine, glaciofluvial

Humus Form

fibrimor, humifibrimor

Overstorey

red pine, white pine, balsam fir, white birch, black spruce

Shrubs/Trees (<10 m)

Acer spicatum, Corylus cornuta, Diervilla lonicera, Lonicera canadensis, balsam fir, white birch, *Linnaea borealis, Chimaphila umbellata, Vaccinium myrtilloides, Vaccinium angustifolium*

Herbs and Graminoids

Aster macrophyllus, Streptopus roseus, Aralia nudicaulis, Clintonia borealis, Trientalis borealis, Maianthemum canadense, Cornus canadensis, Oryzopsis asperifolia

Mosses and Lichens

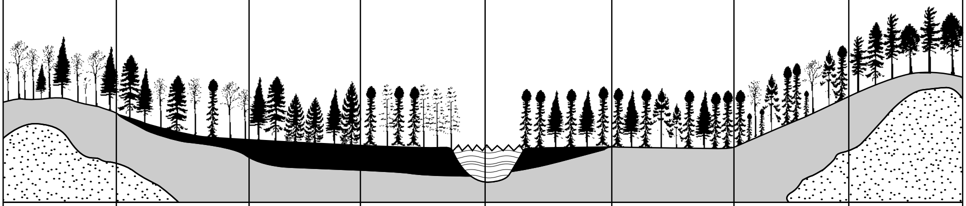
Pleurozium schreberi, Ptilium crista-castrensis, Hylocomium splendens, Dicranum polysetum

Comments

Characteristic V-types include V12, V13, V26 and V27. Wide variety of other V-types may be expected. Topography varied. Principal soil type is S4, with inclusions of SS7.

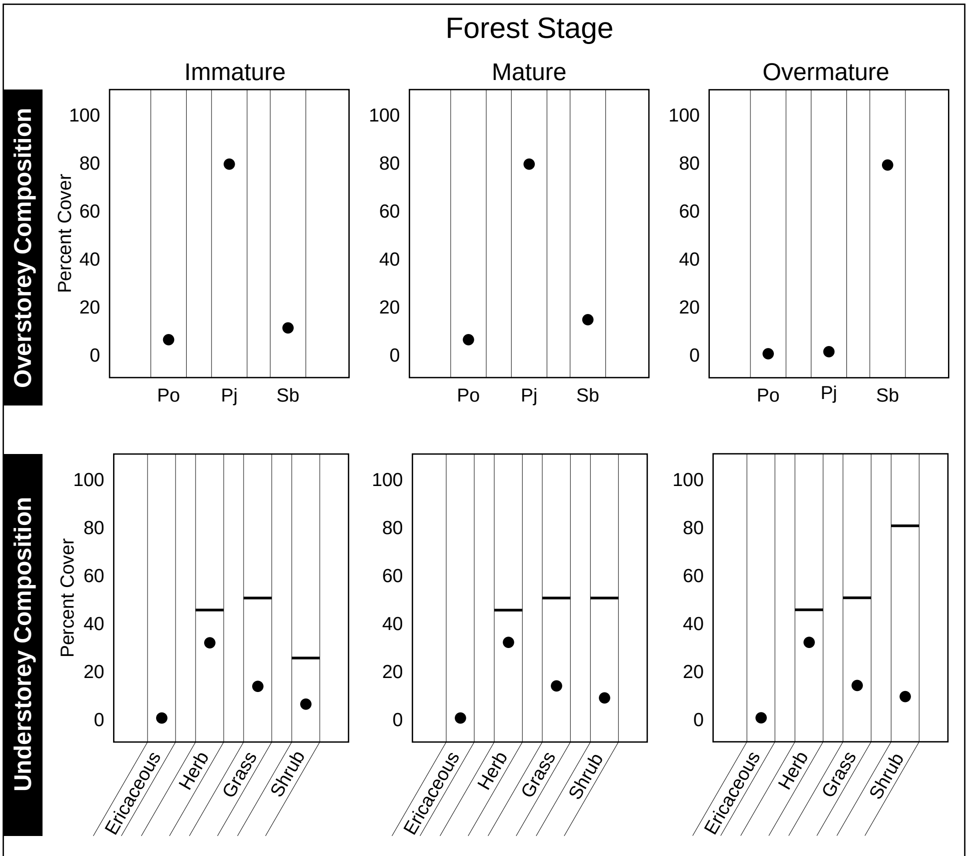
Typical Landscape Associations

Typical Ecosite Sequence on Silty to Clayey Glaciolacustrine and Alluvial Material



Po (Bw-Bf)	Po-Sw-Bw (Sb-Bf)	Ce-Bf-Sw	Ta-Sb	Sb (Bf)	Sb (Bf-Pj)	Sb-Pj (Po-Bw)	Pw-Pr (Bw)
ES28 Hardwood-Fir-Spruce Mixedwood: Fresh, Silty Soil	ES33 Hardwood-Fir-Spruce Mixedwood: Moist, Silty-Clayey Soil	ES37 Rich Swamp: Cedar (Other Conifer): Organic Soil	ES36 Intermediate Swamp: Black Spruce (Tamarack): Organic Soil	ES31 Spruce-Pine/ Feathermoss: Moist, Silty-Clayey Soil	ES25 Pine-Spruce/ Feathermoss: Fresh, Silty Soil	ES26 Spruce-Pine/ Feathermoss: Fresh, Fine Loamy-Clayey Soil	ES24 Red Pine-White Pine: Fresh, Fine Loamy Soil
V5 Aspen Hardwood	V9 Trembling Aspen Mixedwood	V21 Cedar (inc. Mixedwood)/ Mountain Maple	V23 Tamarack (Black Spruce)/ Speckled Alder/ Labrador-tea	V34 Black Spruce/ Labrador-tea/ Feathermoss (Sphagnum)	V31 Black Spruce-Jack Pine/ Tall Shrub/ Feathermoss	V32 Jack Pine-Black Spruce/ Ericaceous Shrub/ Feathermoss	V26 White Pine Conifer
S4 Fresh/Silty-Silt Loamy	S9 Moist/Silty-Silt Loamy	S12F Wet/Organic (Feathermoss)	S12S Wet/Organic (Sphagnum)	S10 Moist/Fine Loamy-Clayey	S4 Fresh/Silty-Silt Loamy	S5 Fresh/Fine Loamy	SS7 Moist/Sandy
Fresh	Moist	Wet	Wet	Moist	Fresh	Fresh	Fresh

Site Structure and Composition



Advance Growth

Forest Stage

	Immature		Mature		Overmature	
	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)
Sb	0	N/A	0	N/A	0	N/A
Bf	197	N/A	1722	N/A	191	N/A

Seedbed

	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen
	1	45	0	54	0	1	45	0	54	0	1	45	0	54	0

Coarse Woody Debris

	Logs	Debris	Logs	Debris	Logs	Debris
	N/A	N/A	N/A	N/A	N/A	N/A

Vegetation and Soil Type Relationships

(number of plots with defined combinations)

White Pine Mixedwood 12	Red Pine Mixedwood 13	White Pine Conifer 26	Red Pine Conifer 27		
▒	▒				
			1	□	S4 – Fresh / Silty – Silt Loamy
	1			▒	S5 – Fresh / Fine Loamy
		1	2	▒	SS7– Shallow – Moderately Deep / Silty – Fine Loamy - Clayey

Description of Soil and Vegetation
▒ Characteristic Common
■ Common Inclusions
□ Characteristic Uncommon

Selected Species Habitat Use

Species	Forest Stage					Special Habitat Preferences
	Pre-sapling	Sapling	Immature	Mature	Overmature	
Spruce Grouse						
Great Grey Owl						
Black-backed Woodpecker						
Pileated Woodpecker				○	●	snags, downed woody debris
Least Flycatcher				○	○	often found near open spaces (edge, riparian)
Boreal Chickadee				○	○	snags
Swainson's Thrush			○	○	○	
Nashville Warbler		○	○	○		high level of light penetration, preferably with shallow undergrowth
Connecticut Warbler						
White-throated Sparrow	○	○			○	numerous openings with low dense vegetation
Northern Flying Squirrel				○	○	snags
Southern Red-backed Vole		○	○	●	●	downed woody debris
Meadow Vole	●					fields, grassy meadows
Marten			○	●	●	snags, downed woody debris
Woodland Caribou (winter)						
Woodland Caribou (hab. rank)						
White-tailed Deer (forage)	○	○				
White-tailed Deer (cover)						
Moose (forage)	○	○			○	
Moose (cover)			●	●	○	

○ Used Habitat ● Preferred Habitat

Successional Relationships - Natural

This ecosite is characterized by a homogeneous main canopy dominated by red or white pine — most often white pine. Balsam fir, white birch and aspen occur as scattered individuals throughout the main canopy although they are shorter-lived. Canopy closure is relatively high in younger stand with older stands exhibiting a more open canopy structure associated with loss of individual trees. Stand ages commonly range from 60 to 135 years although those with a well-developed super-canopy of white pine may be as old as 275 years.

White birch and aspen are often found in the upper sub-canopy of ES24 although their occurrence and percent cover remains low. White birch, red maple and white pine are also common constituents of the lower sub-canopy in older age stands. Balsam fir and white birch are the most frequent species in the sapling layer but rarely enters the tall shrub or sub-canopy layers.

Succession is towards a more open two-tiered canopy dominated by white pine but in comparison to ES11 and 15, the percent canopy cover of the overstorey pine in ES24 remains high. Tree cover is somewhat higher than for other red and white pine ecosites. Older stands are characterized by a semi-closed canopy of white pine. Gaps in the super-canopy create favorable openings for the regeneration and growth of woody shrubs in the understorey. Balsam fir density and cover increases through time, but is generally restricted to the lower and upper sub-canopies. The presence and abundance of eastern white cedar increase over time but it remains a relatively minor component of this ecosite. The resistance of individual white cedar trees to low-to-moderate-intensity understorey fires is enhanced by their thick bark. This adaptation ensures their continued presence beneath a white pine super canopy. White birch remains a significant component in both the lower and upper canopies even at older ages — the result of one to several low to moderate severity surface fires creating favorable seedbeds and/or stimulating white birch basal sprouting.

The shrub layer is dominated by beaked hazel and mountain maple which occur at high frequency and high percent cover. Beaked hazel also occurs under these moisture regimes but is often associated with sub-surface water movement and rapidly drained conditions created by increased stone content. Red maple may occur as a significant component of the sub-canopy towards the Minnesota and Manitoba borders. The herb layer remains relatively rich throughout succession. Ground vegetation consisting of large-leaf aster, wild sarsaparilla, blue bead lily, bush honeysuckle, *Oryzopsis asperifolia* and clubmosses common. Total cover by moss species remains low. The most frequent and abundant species are *Pleorozium schreberi* and *Dicranum polysetum*.

Tall and low shrub cover within the stand declines thru time, while the occurrence of wild red raspberry increases as gaps develop in the main canopy. Total herb cover is initially low and continues to decline through time. Forest floor cover by *Pleorozium schreberi* and *Dicranum polysetum* increases with time reflecting changes in understorey micro-environment and changes in LFH composition and litter chemistry. Species richness, diversity and evenness are very similar in the younger and older stands. Tree and shrub diversity decline, while herb and cryptogram diversity increase.

The successional dynamics of these ecosites is dependent upon substrate conditions, fire frequency and intensity and physiography. Although red pine and white pine cones are not serotinous, fire is critical to their regeneration. Continued recruitment of red and white pine into ES24 is greatest in stands where low intensity surface fires occurred every 20 to 40 years, and where the interval between catastrophic crown fires is >100 years. More intense surface fires on dry sites kill a proportion of mature trees creating gaps in the main canopy and promoting regeneration of red and white pine and white birch. Understorey fires of moderate severity are required to reduce the abundance and distribution of woody shrub species and create suitable opening and seedbeds capable of supporting the regeneration of tree species.

Long-term succession (>250 years) will be directed towards a super canopy of white pine with red pine distributed along rock ridges and/or on locally abundant coarse-textured soils. An understorey of white birch, balsam fir and the tall shrubs will be maintained in the absence of fire. Defoliation of the balsam fir component by the eastern spruce budworm will lead to rapid expansion of the woody shrub component in the understorey. Stand recruitment of white pine is facilitated by local disturbances such as surface fires, windthrow and natural mortality of mature individuals. Regional physiography and landform features are important factors determining successional trajectories in old-growth red and white pine forests.

Successional Relationships - Post-harvest

Response following harvest:

Varying soil conditions on 'moderately deep to deep' sites result in different responses depending on the forest stand conditions present at time of harvest. The presence of a viable red or white pine seed source from residual standards or adjacent stands will contribute to the perpetuation of those species on this ecosite provided the herbaceous and woody shrub component is controlled. An aspen component present in the original canopy is likely to be maintained through vegetative suckering while the post-harvest densities of white birch will be low due to lack of a suitable supply and duration of receptive seedbed.

Stocking of black spruce and balsam fir in the sub-canopy or as advance growth in the understorey will be greatly reduced following canopy removal due to exposure, sunscald and increased droughtiness of the site. However, substantial numbers of all-aged balsam fir seedlings are likely to survive in the low shrub layer. Harvesting will release these seedlings and in the absence of fire or mechanical disturbance they will rapidly grow to occupy the site.

Response following harvest and mechanical site preparation:

Disturbance and mixing of the LFH with mineral soil will create suitable seedbed for red and white pine, and black spruce. If black spruce is present in the original stand, its presence in the future stand may be enhanced by scarification on the site. Mechanical scarification will greatly reduce the density of residual balsam fir seedlings and saplings.

Response following harvest and prescribed fire:

Following prescribed fire and dependant upon fire intensity and severity, the growth of medium to wide-bladed grasses and herbaceous species is stimulated. These species will quickly dominate the site within two years. Medium to high severity surface fires will be effective in reducing future competition from woody shrubs and exposing a mineral soil seedbed suitable for conifer establishment. Prescribed fire will destroy any black spruce or balsam fir advance growth and will usually girdle any seedling red and white pine. Moderate to severe intensity surface fires will completely remove the surface organic horizons and kill any aspen present on the cutover.

Site Productivity

Site Index by species and NWO FEC Soil Type

Site Index (breast height age 50 years)

Soil Type	Species		
	Sb	Pj	Po
S4	13.8	21.2	21.4
S5	16.8	N/A	20.3
SS7	13.7	14.2	22.2

Black Spruce Advance Regeneration

	Vegetation Type			
	V12	V13	V26	V27
Stocking (%)	N/A	N/A	N/A	N/A
Stocking Range	N/A	N/A	N/A	N/A
Stems per ha	N/A	N/A	N/A	N/A

V12 and V13 are the characteristic vegetation types. V26 and V27 are common inclusions on this ecosite.

Red pine-white pine dominated vegetation types V12, V13, V26 and V27 were not surveyed for black spruce advance growth. Due to the low density of black spruce in these V-types black spruce advance growth is assumed to be low.

Natural Ingress Probability and Density (ten years post-disturbance)

No information available

Critical Comments

- Heavy woody shrub and hardwood tree competition from mountain maple, green and speckled alder, beaked hazel and balsam fir should be expected. *Calamagrostis canadensis* is often abundant following harvest when excessive amounts of soil are disturbed.
- Extremely varied topography often creates deeper soil pockets which will support various amounts of trembling aspen and white birch. *Armillaria* spp. infestations may develop on sites with a significant aspen content (V12, V13).
- White pine blister rust *(Cronartium ribicola*) is endemic and may affect white pine on the site.
- Stands with a significant component of balsam fir, white spruce or black spruce in the secondary canopy are vulnerable to spruce budworm.
- Natural regeneration of black spruce and jack pine limited by available local seed supply and lack of suitable supply and duration of receptive seedbed.
- Natural regeneration heavily dominated by balsam fir.
- Extensive slash resulting from, dead and dying balsam fir, residual balsam fir and balsam fir advance growth will limit the effectiveness of intermittent patch scarifiers and passive disc-trenchers.
- Soil/site conditions limit the use of hexazinone products for chemical site preparation

Site Characteristics, Limitations and Hazard Potential

Characteristics							Limitations				Hazard Potential				
LFH Layer	Soil Texture	Depth to Bedrock	Stoniness	Moisture Regime	Terrain	Competition	Windthrow	Frost Heaving	Drought/Desiccation	Seasonal Flooding	Compaction	Rutting	Soil Erosion	Biomass & Nutrient Removal	Silvicultural Activities
1	1,3				3								1,3		Harvesting
1,2	1,3				3	1,4		1					1,3		Renewal
	1,3					1,4									Tending

Footnotes:

1. Disturbance of the forest floor on fine textured soils will promote non-crop vegetation and increase potential for erosion and frost heaving.
2. LFH layer is a poor seedbed.
3. Soil erosion hazard increases with silt content. Hazard is moderate to high on slopes greater than 10 percent.
4. High competition with mountain maple, beaked hazel, white birch and aspen as the principle competitors.

Opportunities

- This ecosite is ideal for managing red and white pine through an 'extended rotation.'
- No treatment will eventually result in the dominance of later successional species at the expense of the pines, and significantly increase wildfire hazard potential.
- Selection or shelterwood harvest to maintain red and white pine component is effective treatment. Pre-harvest understory prescribed fire will control competing vegetation, create receptive seedbed and reduce the cedar, white birch and balsam fir component.
- Competition levels are highly variable; after harvest, these sites can only be converted to black spruce or jack pine dominated stands through planting.
- Soil active herbicides generally available for use on fine textured soils.

Silvicultural Intensity Considerations

Species Objective	Site Productivity	Degree of Effort to Reach Free-to-grow
Black spruce	1	3
Jack pine	1	3
Aspen	1	(1)*

Site Productivity - Site Productivity class (prime land productivity class) based upon height of dominant trees at age 50 years (breast height).

Degree of Effort

1 = Extensive
2 = Basic
3 = Intensive
4 = Highly Intensive

Silvicultural Interpretations for the Establishment of Black Spruce

Silvicultural System **• Harvest Method**		**Comments**
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	R	Residual stand will not contribute seed of sufficient quantity. However, this cutting technique may be prescribed to meet other management objectives.
- Patch	R	See Strip/Block comment.
- Seed-tree	NR	Potential for natural seeding is very low due to infrequent occurrence of black spruce in the original stand.
Shelterwood	NR	Black spruce is mid-tolerant and is susceptible to windthrow after thinning of closed canopy stands.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	R	
Tree-length	R	Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	R	See Tree-length comment.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Black Spruce (con't)

Renewal Treatments	Comments	
Site Preparation		High competition on this site.
• Mechanical	R	Minimize mineral soil exposure on clays to reduce the incidence of soil baking and/or frost heaving, and to prevent increased competition from non-crop vegetation on a mixed mineral/organic microsite. Techniques, timing and sequencing of treatments should be carefully considered.
• Chemical	R	Some herbicide-resistant non-crop species may occur on this site.
• Prescribed Burn	R	Severity of burn will affect vegetation response.
Regeneration • Natural - Advance Growth	NR	Insufficient data exist. Vegetation types imply low levels of black spruce advance growth.
- Seed	NR	Potential for natural seeding is very low due to infrequent occurrence of black spruce in the original stand.
Vegetative (coppice)	NR	Black spruce does not coppice.
• Artificial - Planting	R	Plant close to the mineral/organic interface.
- Seeding	NR	The distribution, abundance and vigour of competing vegetation precludes survival and growth of seed origin black spruce.
- Scarification	NR	Cone supply is low due to low density of black spruce in the original stand.
Tending Treatments		
Cleaning		High competition on this site.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Ground-Chemical comment.
Spacing	R	Spacing is usually not necessary since black spruce natural regeneration is minimal.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine

Silvicultural System **• Harvest Method**	**Comments**	
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	R	Residual stand will not contribute seed of sufficient quantity or genetic quality. However, this cutting technique may be prescribed to meet other management objectives.
- Patch	R	See Strip/Block comment.
- Seed-tree	NR	Potential for natural seeding is very low due to infrequent occurrence of jack pine in the original stand.
Shelterwood	NR	Jack pine is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	R	
Tree-length	R	Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	R	See Tree-length comment.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine (con't)

Renewal Treatments	Comments	
Site Preparation		High competition on this site.
• Mechanical	R	Techniques, timing and sequencing of treatments should be carefully considered. Minimize mineral soil exposure on clays to reduce the incidence of soil baking and/or frost heaving, and to prevent increased competition from non-crop vegetation on a mixed mineral/organic microsite.
• Chemical	R	Some herbicide-resistant non-crop species may occur on this site.
• Prescribed Burn	R	Severity of burn will affect vegetation response.
Regeneration • Natural - Advance Growth	NR	Jack pine does not regenerate under a closed canopy.
- Seed	NR	Insufficient data exist. Seed supply believed to be limiting.
-Vegetative (coppice)	NR	Jack pine does not coppice.
• Artificial - Planting	R	Plant close to the mineral/organic interface.
- Seeding	NR	Smothering of seedbeds with hardwood litter will limit success. In addition, the distribution, abundance and vigour of non-crop vegetation precludes survival and growth of seed origin jack pine.
- Scarification	NR	Cone supply is limiting due to the low presence of jack pine in the original stand. Cone scattering will give variable results.
Tending Treatments		
Cleaning		High competition on this site.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing is usually not necessary since jack pine natural regeneration is minimal.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Aspen

Silvicultural System **• Harvest Method**	**Comments**	
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	CR	Strips should be at least 20 m wide to warm the soil and stimulate suckering. Strip cutting can also be prescribed to meet other management objectives.
- Patch	CR	Openings 0.4 ha in size are the minimum acceptable to stimulate aspen suckering. Patch cutting can also be prescribed to meet other management objectives.
- Seed-tree	NR	Leaving live aspen will reduce suckering.
Shelterwood	NR	Aspen is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	R	
Tree-length	R	Slash remaining on the site will reduce soil temperature and sucker production.
Cut-to-length/Shortwood	R	See Tree-length comment. Concentration of slash in rows by single grip harvesters will create an uneven distribution of aspen suckers.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

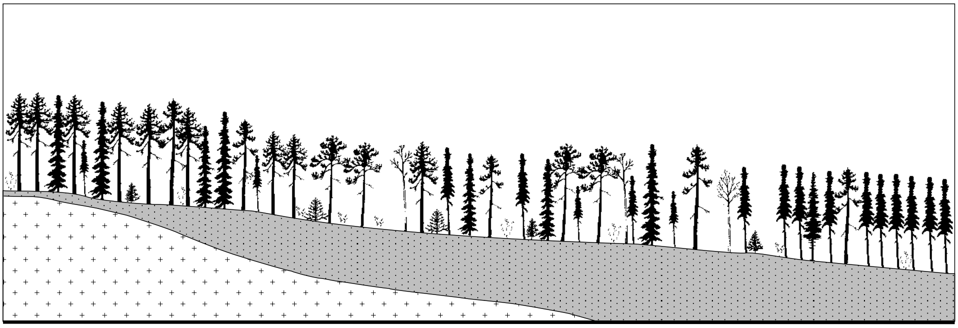
Silvicultural Interpretations for the Establishment of Aspen (con't)

Renewal Treatments	Comments	
Site Preparation • Mechanical	NR	See Scarification (Section II, Book I).
• Chemical	R	Chemical site preparation may be used on sites where the residual overstorey will negatively affect root suckering. 2,4-D is recommended since it will remove the overstorey without damaging the aspen root systems.
• Prescribed Burn	R	
Regeneration • Natural - Advance Growth	NR	Aspen does not regenerate under a closed canopy.
- Seed	NR	Aspen regeneration from seed is highly variable.
- Vegetative (coppice)	R	
• Artificial - Planting	NR	Insufficient data and/or field experience exist to recommend this technique. Planting of aspen seedlings may be considered when existing aspen has deteriorated to a point where vegetative regeneration is unlikely or undesirable.
- Seeding	NR	Insufficient data and/or field experience exist to recommend this technique.
- Scarification	R	
Tending Treatments		
Cleaning		High competition on this site. High initial densities and rapid early growth of aspen suckers will ensure their successful renewal.
• Manual	NR	
• Mechanical	NR	
• Chemical - Ground	NR	
- Aerial	NR	
Spacing	R	Site quality and timing is critical for the success of this treatment.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

ES 25

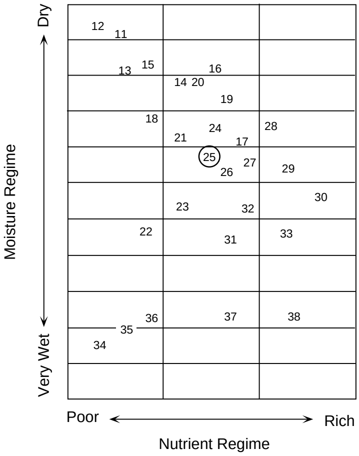
Pine–Spruce / Feathermoss: Fresh, Silty Soil



approximately 250 m

General Description

Overstory dominated by jack pine and black spruce. Scattered occurrences of trembling aspen, white birch and balsam fir. Typically shrub- and herb-poor in younger fire origin stands but may vary to shrub- and herb-rich with increased silt content or reduction in crown closure. Soils are fresh, well to moderately well drained; silt to silt loam. Developed on lacustrine and glaciofluvial parent material. Ground cover consists of feathermoss and conifer litter.



Soil types
S4, SS7

Mode of Deposition
lacustrine, glaciofluvial

Humus Form
fibrimor, humifibrimor

Overstorey
jack pine, black spruce, trembling aspen, white birch, balsam fir

Shrubs/Trees (<10 m)
black spruce, *Diervilla lonicera, Linnaea borealis, Vaccinium spp., Gaultheria hispidula, Ledum groenlandicum*

Herbs and Graminoids
Clintonia borealis, Trientalis borealis, Aralia nudicaulis, Maianthemum canadense, Cornus canadensis

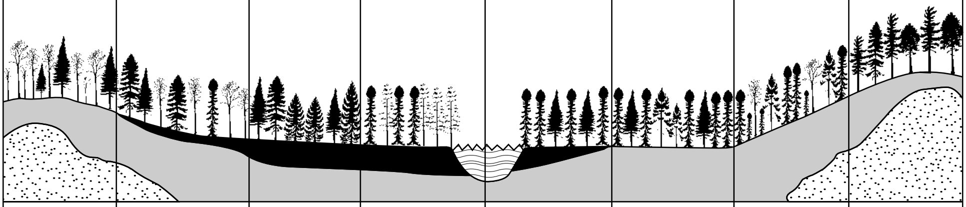
Mosses and Lichens
Pleurozium schreberi, Ptilium crista-castrensis, Hylocomium splendens, Dicranum polysetum, Cladina rangiferina

Comments

Relatively homogeneous ecosite with characteristic V-types V31 and V32. Expect gradations to V20, V10 and V11 where local pockets of hardwood occur, and to V33 where the spruce component becomes more dense. Occasionally this ecosite may be represented by relatively pure jack pine with a shrub- and herb-rich understory (V17). Usually occurring in rolling terrain and grading to ES31 on low, level areas or depressions.

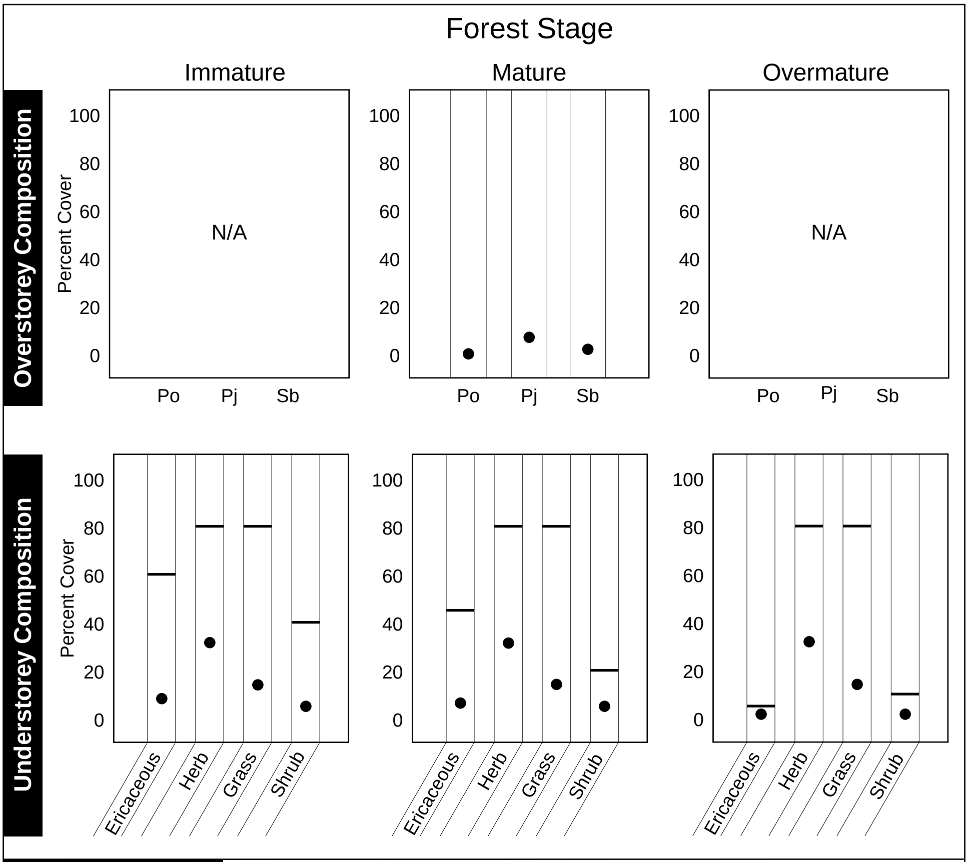
Typical Landscape Associations

Typical Ecosite Sequence on Silty to Clayey Glaciolacustrine and Alluvial Material



Po (Bw-Bf)	Po-Sw-Bw (Sb-Bf)	Ce-Bf-Sw	Ta-Sb	Sb (Bf)	Sb (Bf-Pj)	Sb-Pj (Po-Bw)	Pw-Pr (Bw)
ES28 Hardwood-Fir-Spruce Mixedwood: Fresh, Silty Soil	ES33 Hardwood-Fir-Spruce Mixedwood: Moist, Silty-Clayey Soil	ES37 Rich Swamp: Cedar (Other Conifer): Organic Soil	ES36 Intermediate Swamp: Black Spruce (Tamarack): Organic Soil	ES31 Spruce-Pine/ Feathermoss: Moist, Silty-Clayey Soil	ES25 Pine-Spruce/ Feathermoss: Fresh, Silty Soil	ES26 Spruce-Pine/ Feathermoss: Fresh, Fine Loamy-Clayey Soil	ES24 Red Pine-White Pine: Fresh, Fine Loamy Soil
V5 Aspen Hardwood	V9 Trembling Aspen Mixedwood	V21 Cedar (inc. Mixedwood)/ Mountain Maple	V23 Tamarack (Black Spruce)/ Speckled Alder/ Labrador-tea	V34 Black Spruce/ Labrador-tea/ Feathermoss (Sphagnum)	V31 Black Spruce-Jack Pine/ Tall Shrub/ Feathermoss	V32 Jack Pine-Black Spruce/ Ericaceous Shrub/ Feathermoss	V26 White Pine Conifer
S4 Fresh/Silty-Silt Loamy	S9 Moist/Silty-Silt Loamy	S12F Wet/Organic (Feathermoss)	S12S Wet/Organic (Sphagnum)	S10 Moist/Fine Loamy-Clayey	S4 Fresh/Silty-Silt Loamy	S5 Fresh/Fine Loamy	SS7 Moist/Sandy
Fresh	Moist	Wet	Wet	Moist	Fresh	Fresh	Fresh

Site Structure and Composition



Advance Growth	Forest Stage					
	Immature		Mature		Overmature	
	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)
Sb	1722	N/A	0	N/A	66	N/A
Bf	2133	N/A	191	N/A	191	N/A

Seedbed															
	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen
	0	47	0	53	4	0	47	0	53	4	0	47	0	53	4

Coarse Woody Debris						
	Logs	Debris	Logs	Debris	Logs	Debris
	N/A	N/A	N/A	N/A	N/A	N/A

Vegetation and Soil Type Relationships

(number of plots with defined combinations)

Black Spruce – Jack Pine / Tall Shrub / Feathermoss	Jack Pine – Black Spruce / Ericaceous Shrub / Feathermoss	Trembling Aspen – Conifer / Blueberry / Feathermoss			
31	32	11			
▨	▨	■			
5	9		▨	S4–	Fresh / Silty – Silt Loamy
3	3	1	☐	SS7–	Shallow – Moderately Deep / Silty – Fine Loamy – Clayey

Description of Soil and Vegetation

▨	Characteristic Common
■	Common Inclusions
☐	Characteristic Uncommon

Selected Species Habitat Use

Species	Forest Stage					Special Habitat Preferences
	Pre-sapling	Sapling	Immature	Mature	Overmature	
Spruce Grouse				○	○	
Great Grey Owl						
Black-backed Woodpecker				●	●	snags
Pileated Woodpecker						
Least Flycatcher						
Boreal Chickadee				○	○	snags
Swainson's Thrush			○	○	○	
Nashville Warbler		○	○	○		high level of light penetration, preferably with shallow undergrowth
Connecticut Warbler	○	○				nests in spruce bogs/tamarack fens with well developed understorey
White-throated Sparrow	○	○			○	numerous openings with low dense vegetation
Northern Flying Squirrel				○	○	snags
Southern Red-backed Vole		○	○	●	●	downed woody debris
Meadow Vole	●					fields, grassy meadows
Marten			○	●	●	snags, downed woody debris
Woodland Caribou (winter)						
Woodland Caribou (hab. rank)			○	○	○	
White-tailed Deer (forage)	○	○				
White-tailed Deer (cover)						
Moose (forage)	○	○				
Moose (cover)			○	○	○	

○ Used Habitat ● Preferred Habitat

Successional Relationships - Natural

This ecosite is characterized by a closed, mixed jack pine - black spruce canopy. Jack pine is almost exclusively found in the canopy, whereas black spruce is distributed throughout the canopy, sub-canopy and sapling layers. Jack pine recruitment is restricted to the first few years after fire while black spruce recruitment continues for at least 60 years post catastrophic disturbance. White birch, balsam fir, trembling aspen and/or white spruce are often present in the upper two canopies as well as in the sapling layer. Stand ages range from 45 to 186 years with the majority of sites occurring between 70 to 115 years of age.

Total shrub cover is low, and ericaceous shrubs predominate (mainly *Vaccinium* spp., *Gaultheria hispidula*, *Ledum groenlandicum* and *Rosa acicularis*). *Ledum groenlandicum* is often present on moist sites and generally occurs at moderate to high cover. Tall shrubs are of less importance on this ecosite. Non-ericaceous shrubs and herbs occur with low frequency and/or cover. The forest floor is primarily covered by *Pleurozium schreberi* although *Dicranum polysetum*, *Ptilium crista-cristensis* and *Hylocomium splendens* are also frequent. Species richness, diversity and evenness are low compared to the other ecosites.

The successional trajectory indicates increased dominance by black spruce, in both the canopy and sub-canopy layers. Like ES22, black spruce recruitment into the stand remains strong and total canopy cover does not declines over time. Recruitment of black spruce is initially contemporaneous with jack pine and then becomes gradual or episodic. Episodic recruitment usually follows low-intensity surface fire. This results in a dense, uneven-aged monodominant black spruce stand.

Some relict jack pine may occur in older stands. White birch which may show moderate to strong regeneration in more open canopy sites and/or in areas of windthrow, persists in some older stands. Balsam fir regenerates well in the understorey beginning at or about 30 years of age provided a seed source is nearby. A slight increase in tree level diversity occurs at older ages reflecting the higher frequency of white birch, trembling aspen and balsam fir.

It has been speculated that mixed jack pine and black spruce stands represent a successional stage towards fir-spruce dominance. However, regional data demonstrates that although balsam fir is often present in the sapling layer it seldom enters the canopy of older stands. Differential mortality of balsam fir on this ecosite may be attributable to the combined effects of low nutrient availability, ungulate herbivory, and spruce budworm infestation.

Tall and low shrub cover will decline over time after 100 years as canopy closure is maintained. Herb cover declines steadily. Moss species continue to dominate the forest floor. Total herb cover is generally less than that of shrubs and also declines, particularly in older stands.

Successional Relationships - Post-harvest

Response following harvest:

The presence of a viable black spruce or jack pine seed source from residuals or adjacent stands will contribute to the perpetuation of those species on this ecosite. Jack pine in the original stand will make the likelihood of jack pine ingress greater. An aspen component present in the original canopy is likely to be maintained through vegetative suckering while birch will be maintained through seed origin reproduction.

A low probability exists for black spruce advance growth to occur in the understorey in the undisturbed stand. Stocking of black spruce and balsam fir in the sub-canopy or as advance growth in the understorey will be greatly reduced following canopy removal due to exposure, sunscald and increased droughtiness of the site.

Proliferation of herbs and woody shrubs is common. Exposed feathermoss quickly dies following removal of the overstorey.

Response following harvest and mechanical site preparation:

Disturbance and mixing of the LFH with mineral soil will create suitable seedbed for black spruce and jack pine. If jack pine is present in the original stand, its presence in the future stand may be enhanced by scarification on the site.

Soil disturbance will stimulate the establishment and growth of woody shrubs and will stimulate hardwood suckering especially from aspen. Mechanical site preparation and the exposure or mixing or mineral and organic soils will greatly stimulate the establishment of grasses and wild raspberry. Retention of an intact forest floor condition will reduce non-crop species on site.

Response following harvest and prescribed fire:

Following fire, the growth of trembling aspen, ericaceous shrubs (blueberry) and herbs is stimulated. These species can quickly dominate the site within two years. Moderate to high intensity surface fires will be effective in reducing future competition from woody shrubs but will result in a less-than-favorable exposed mineral soil seedbed suitable for conifer establishment. Prescribed fire will destroy any black spruce or balsam fir advance growth and will usually girdle any seedling jack pine. Moderate to severe intensity surface fires will completely remove the surface organic horizons and kill any hardwood shrubs or aspen present on the cutover.

Site Productivity

Site Index by species and NWO FEC Soil Type

Site Index (breast height age 50 years)

Soil Type	Species		
	Sb	Pj	Po
S4	13.8	21.2	21.4
SS7	13.7	14.2	22.2

Black Spruce Advance Regeneration

	Vegetation Type	
	V31	V32
Stocking (%)	19	32
Stocking Range	0 – 55	0 – 80
Stems per ha	1000	3100

V31 and 32 are the characteristic vegetation types.

This ecosite is dominated by jack pine and black spruce with scattered stems of other species.

This ecosite has a low probability of sufficient number and distribution of black spruce advance growth for regeneration purposes.

The number and distribution of black spruce advance growth on this ecosite is positively related to:

- basal area of black spruce in the original stand

and inversely related to:

- percent canopy closure

Natural Ingress Probability and Density (ten years post-disturbance)

Seedbed Condition	Species and Height Class					
	Sb		Pj		Po	
	< 1.0	> 1.0	< 1.0	> 1.0	< 1.0	> 1.0
Duff	X ▓	X ▒	M ░	H ▓	X ░	X ▒
Mineral Soil	Insufficient Data					
Burned	Insufficient Data					

Probability Class

V- < 21%
L- 21 - 40%
M- 41 - 60%
H- 61 - 80%
X- > 80%

Density Class

⬜ < 300
░ 300 - 1000
▒ 1001 - 5000
▓ 5001 - 10000
█ > 10000

- Like ES20, this ecosite also supports abundant natural regeneration of all three major species. In addition, jack pine dominates the overstorey and black spruce the understorey.
- Time to establish full ingress is very similar to that on ES20, at six, nine and nine years for jack pine, black spruce and aspen respectively.
- 50 percent black spruce ingress is achieved at three years (compared to six years on ES20). This may be due to higher competition levels on ES25, causing suitable seedbed to be lost faster than on ES20.

Critical Comments

- Low to moderate competition may be expected from green alder, white birch and aspen (where it exists in the original stand). Stands may be herb- and shrub-rich where silt content is high or gaps exist in the overstorey canopy.
- Ecosites supporting V30, V31, V32, V33, are moderately susceptible to spruce budworm infestation.
- Susceptible to jack pine budworm when jack pine predominates in the canopy.
- Natural regeneration of black spruce limited by available local seed supply, and lack of suitable supply and duration of receptive seedbed, and smothering from hardwood litter.

Site Characteristics, Limitations and Hazard Potential

Characteristics							Limitations				Hazard Potential				
LFH Layer	Soil Texture	Depth to Bedrock	Stoniness	Moisture Regime	Terrain	Competition	Windthrow	Frost Heaving	Drought/Desiccation	Seasonal Flooding	Compaction	Rutting	Soil Erosion	Biomass & Nutrient Removal	Silvicultural Activities
1	1,3			4	3						4	4	1,3		Harvesting
1,2	1,3			4	3	1		1			4	4	1,3		Renewal
	1,3					1									Tending

Footnotes:

1. Disturbance of the forest floor will promote non-crop vegetation and increase potential for erosion and frost heaving.
2. LFH layer is a poor seedbed.
3. Soil erosion hazard increases with silt content. Hazard is moderate to high on slopes greater than ten percent.
4. Fine textured soils are susceptible to compaction and rutting when saturated during the frost free period.

Opportunities

- Potential for moderate to high levels of jack pine and black spruce ingress on this ecosite.
- Creating receptive seedbed through fire or mechanical site preparation is necessary for natural or artificial seeding of pine or spruce. Select phases of this ecosite with lower silt contents to minimize competition for seeding treatments.
- Low intensity scarification to scatter and align jack pine slash will enhance natural regeneration from seed on this low to moderate competition site.
- Planting red and white pine is an option especially where white birch is the dominant non-crop vegetation.
- Jack pine and black spruce seed trees (minimum 20/ha), in conjunction with prescribed fire, offer a cost-effective regeneration strategy on these sites. Target the less competitive sites for this treatment.
- Planting without site preparation possible where LFH has a well developed F and H layer.
- Soil active herbicides generally available for use on fine textured soils.

Silvicultural Intensity Considerations

Species Objective	Site Productivity	Degree of Effort to Reach Free-to-grow
Black spruce	1 – 2	3
Jack pine	1	2
Aspen	1	1

Site Productivity - Site Productivity class (prime land productivity class) based upon height of dominant trees at age 50 years (breast height).

Degree of Effort

1 = Extensive
2 = Basic
3 = Intensive
4 = Highly Intensive

Silvicultural Interpretations for the Establishment of Black Spruce

Silvicultural System **• Harvest Method**		**Comments**
Clearcut • Harvest Method - Conventional	R	
- Strip	R	An assessment of seedbed quality and the quality and quantity of black spruce parent trees in the leave strip is necessary to determine potential of this treatment. Strip width should be less than 40 m due to soil moisture regime. This cutting technique may also be prescribed to meet other management objectives.
- Patch	R	An assessment of seedbed quality and the quality and quantity of black spruce parent trees in the leave patch is necessary to determine potential of this treatment. Careful consideration must be given to the size and configuration of patches due to soil moisture regime. This cutting technique may also be prescribed to meet other management objectives.
- Seed-tree	NR	Potential for seasonal drought will limit success of this treatment.
Shelterwood	NR	Black spruce is mid-tolerant and susceptible to windthrow after thinning of closed canopy stands.
Selection	NR	See Shelterwood comment.
Logging Method		Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season.
Full-tree	R	
Tree-length	R	Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	R	See Tree-length comment.
Renewal Treatments		
Site Preparation		Low to moderate competition on this site. Aspen and white birch may be locally abundant.
• Mechanical	CR	Techniques, timing and sequencing of treatments should be carefully considered. Minimize mineral soil exposure on clays to reduce the incidence of soil baking and/or frost heaving, and to prevent increased competition from non-crop vegetation on a mixed mineral/organic microsite. Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Black Spruce (con't)

Renewal Treatments		**Comments**
• Chemical	R	Some herbicide-resistant non-crop species may occur on this site.
• Prescribed Burn	R	Severity of burn will affect vegetation response.
Regeneration • Natural - Advance Growth	NR	Black spruce advance growth is not of sufficient quantity or distribution to regenerate the site.
- Seed	R	Moderate levels of black spruce ingress. May require supplemental artificial regeneration.
- Vegetative (coppice)	NR	Black spruce does not coppice.
• Artificial - Planting	R	Plant close to the mineral/organic interface.
- Seeding	R	Moderate potential for aerial seeding. An abundant supply of seed from slash is necessary to supplement the aerial seeding. Site preparation is required to create sufficient suitable seedbed.
- Scarification	NR	Site conditions imply moderate levels of black spruce ingress.
Tending Treatments		
Cleaning		Low to moderate competition on this site and cleaning is generally not required.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing is usually not necessary since black spruce natural regeneration is minimal.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine

Silvicultural System **• Harvest Method**		**Comments**
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	R	Residual stand will not contribute seed of sufficient quantity or genetic quality. However, this cutting technique may be prescribed to meet other management objectives.
- Patch	R	See Strip/Block comment.
- Seed-tree	CR	Jack pine seed tree systems are only to be used in conjunction with a post-harvest prescribed burn which creates 50% net mineral soil exposure well distributed across the site.
Shelterwood	NR	Jack pine is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season.
Full-tree	R	
Tree-length	R	Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	R	See Tree-length comment.
Renewal Treatments		
Site Preparation		Low to moderate competition on this site. Aspen and white birch may be locally abundant.
• Mechanical	CR	Techniques, timing and sequencing of treatments should be carefully considered. Minimize mineral soil exposure on clays to reduce the incidence of soil baking and/or frost heaving, and to prevent increased competition from non-crop vegetation on a mixed mineral/organic microsite. Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season.
• Chemical	R	Some herbicide-resistant non-crop species may occur on this site.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine (con't)

Renewal Treatments	**Comments**	
• Prescribed Burn	R	Severity of burn will affect vegetation response. Prescribed burn is required when using the seed tree silvicultural system.
Regeneration • Natural - Advance Growth	NR	Jack pine does not regenerate under a closed canopy.
- Seed	R	High levels of jack pine ingress.
- Vegetative (coppice)	NR	Jack pine does not coppice.
• Artificial - Planting	R	Plant close to the mineral/organic interface.
- Seeding	R	Good distribution of mineral soil seedbeds will contribute to success.
- Scarification	R	High levels of jack pine ingress. Excessive displacement of the organic layer will create a favorable environment for establishment of windborne seed and seedbank species.
Tending Treatments		
Cleaning		Low to moderate competition on this site and cleaning is usually not required.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing will be beneficial where density is high from natural or direct seeding.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Aspen

Silvicultural System **• Harvest Method**		**Comments**
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	CR	Strips should be at least 20 m wide to warm the soil and stimulate suckering. Strip cutting can also be prescribed to meet other management objectives.
- Patch	CR	Openings 0.4 ha in size are the minimum acceptable to stimulate aspen suckering. Patch cutting can also be prescribed to meet other management objectives.
- Seed-tree	NR	Leaving live aspen will reduce suckering.
Shelterwood	NR	Aspen is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season.
Full-tree	R	
Tree-length	R	Slash remaining on the site will reduce soil temperature and sucker production.
Cut-to-length/Shortwood	R	See Tree-length comment. Concentration of slash in rows by single grip harvesters will create an uneven distribution of aspen suckers.
Renewal Treatments		
Site Preparation • Mechanical	NR	See Scarification (Section II, Book I).
• Chemical	R	Chemical site preparation may be used on sites where the residual overstorey will negatively affect root suckering. 2,4-D is recommended since it will remove the overstorey without damaging the aspen root systems.
• Prescribed Burn	R	
Regeneration • Natural - Advance Growth	NR	Aspen does not regenerate under a closed canopy.
- Seed	NR	Aspen regeneration from seed is highly variable.

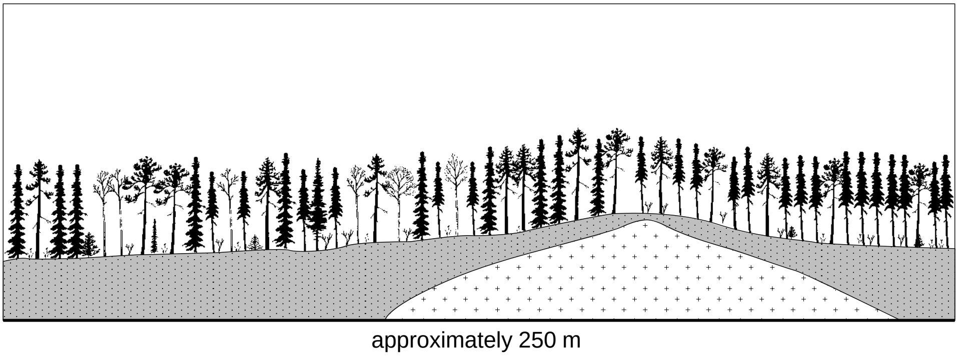
R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Aspen (con't)

Renewal Treatments	Comments	
- Vegetative (coppice)	R	
• Artificial - Planting	NR	Insufficient data and/or field experience exist to recommend this technique. Planting of aspen seedlings may be considered when existing aspen has deteriorated to a point where vegetative regeneration is unlikely or undesirable.
- Seeding	NR	Insufficient data and/or field experience exist to recommend this technique.
- Scarification	R	
Tending Treatments		
Cleaning		Low to moderate competition on this site. High initial densities and rapid early growth of aspen suckers will ensure their successful renewal.
• Manual	NR	
• Mechanical	NR	
• Chemical - Ground	NR	
- Aerial	NR	
Spacing	R	Site quality and timing is critical for the success of this treatment.

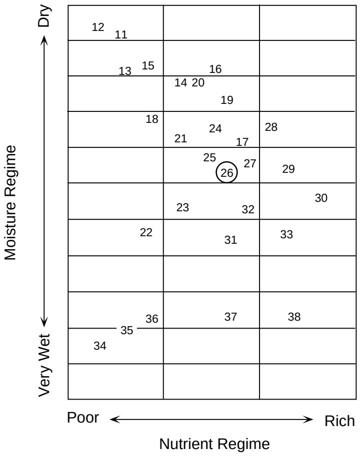
R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

ES 26 Spruce–Pine / Feathermoss: Fresh, Fine Loamy–Clayey Soil



General Description

Overstory dominated by black spruce and jack pine. Occasionally has scattered occurrences of trembling aspen, white birch and balsam fir. Typically shrub- and herb-poor. Soils fresh, well to moderately well drained, fine loamy–clayey; developed primarily on lacustrine parent material. Ground cover consists of feathermoss, conifer litter and wood.



Soil types
S5, S6, SS7

Mode of Deposition
lacustrine, morainal

Humus Form
fibrimor, humifibrimor

Overstorey
black spruce, jack pine, balsam fir, trembling aspen, white birch, white spruce

Shrubs/Trees (<10 m)
Ledum groenlandicum, Gaultheria hispidula, black spruce, *Vaccinium myrtilloides, Vaccinium angustifolium, Linnaea borealis,* balsam fir, *Rosa acicularis, Diervilla lonicera, Rubus pubescens*

Herbs and Graminoids
Clintonia borealis, Coptis trifolia, Maianthemum canadense, Cornus canadensis, Petasites frigidus

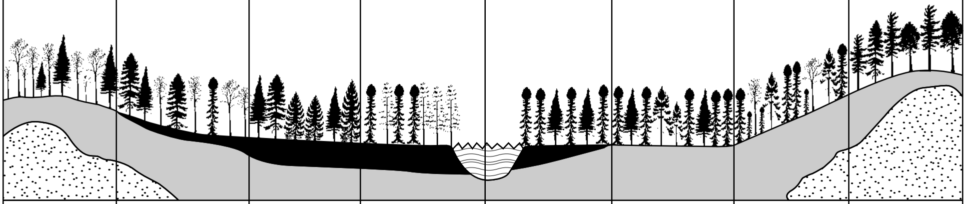
Mosses and Lichens
Pleurozium schreberi, Ptilium crista-castrensis, Hylocomium splendens, Dicranum polysetum

Comments

Relatively complex ecosite with characteristic V-types including V20, V31, V32 and V33. Expect V17 and V19 to provide shrub- and herb-rich phases, and V36 and V34 on toe slopes and depressions. Soils generally deep but may often have inclusions of SS9 peaty phase soils. May occur as a complex with ES31 in rolling or broken terrain with impeded drainage.

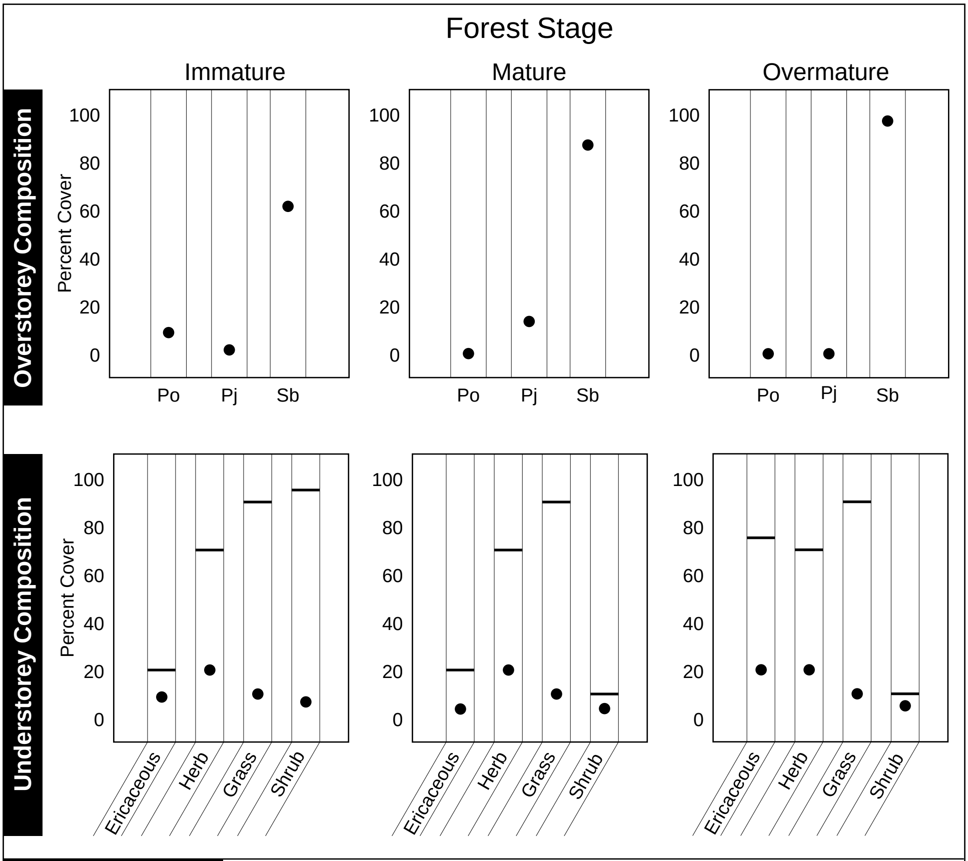
Typical Landscape Associations

Typical Ecosite Sequence on Silty to Clayey Glaciolacustrine and Alluvial Material



Po (Bw-Bf)	Po-Sw-Bw (Sb-Bf)	Ce-Bf-Sw	Ta-Sb	Sb (Bf)	Sb (Bf-Pj)	Sb-Pj (Po-Bw)	Pw-Pr (Bw)
ES28 Hardwood-Fir-Spruce Mixedwood: Fresh, Silty Soil	ES33 Hardwood-Fir-Spruce Mixedwood: Moist, Silty-Clayey Soil	ES37 Rich Swamp: Cedar (Other Conifer): Organic Soil	ES36 Intermediate Swamp: Black Spruce (Tamarack): Organic Soil	ES31 Spruce-Pine/ Feathermoss: Moist, Silty-Clayey Soil	ES25 Pine-Spruce/ Feathermoss: Fresh, Silty Soil	ES26 Spruce-Pine/ Feathermoss: Fresh, Fine Loamy-Clayey Soil	ES24 Red Pine-White Pine: Fresh, Fine Loamy Soil
V5 Aspen Hardwood	V9 Trembling Aspen Mixedwood	V21 Cedar (inc. Mixedwood)/ Mountain Maple	V23 Tamarack (Black Spruce)/ Speckled Alder/ Labrador-tea	V34 Black Spruce/ Labrador-tea/ Feathermoss (Sphagnum)	V31 Black Spruce-Jack Pine/ Tall Shrub/ Feathermoss	V32 Jack Pine-Black Spruce/ Ericaceous Shrub/ Feathermoss	V26 White Pine Conifer
S4 Fresh/Silty-Silt Loamy	S9 Moist/Silty-Silt Loamy	S12F Wet/Organic (Feathermoss)	S12S Wet/Organic (Sphagnum)	S10 Moist/Fine Loamy-Clayey	S4 Fresh/Silty-Silt Loamy	S5 Fresh/Fine Loamy	SS7 Moist/Sandy
Fresh	Moist	Wet	Wet	Moist	Fresh	Fresh	Fresh

Site Structure and Composition



Advance Growth	Forest Stage					
	Immature		Mature		Overmature	
	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)
Sb	167	N/A	2500	N/A	2099	N/A
Bf	2449	N/A	2382	N/A	2987	N/A

Seedbed															
	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen
	40	32	0	8	20	40	32	0	8	20	40	32	0	8	20

Coarse Woody Debris						
	Logs	Debris	Logs	Debris	Logs	Debris
	N/A	N/A	N/A	N/A	N/A	N/A

Vegetation and Soil Type Relationships

(number of plots with defined combinations)

Black Spruce / Feathermoss	Black Spruce – Jack Pine / Tall Shrub / Feathermoss	Jack Pine – Black Spruce / Ericaceous Shrub / Feathermoss	Black Spruce Mixedwood / Feathermoss		
33	31	32	20		
▨	▨	☐	☐		
3	2	1		▨	S5 – Fresh / Fine Loamy
6	8	7	1	▨	S6 – Fresh / Clayey
2	3	3	2	☐	SS7– Shallow – Moderately Deep / Silty – Fine Loamy – Clayey

Description of Soil and Vegetation

▨ Characteristic Common

■ Common Inclusions

☐ Characteristic Uncommon

Selected Species Habitat Use

Species	Forest Stage Pre-sapling	Sapling	Immature	Mature	Overmature	Special Habitat Preferences
Spruce Grouse				○	○	
Great Grey Owl				○	○	tamarack bogs preferred for nesting (use nests of other raptors)
Black-backed Woodpecker				●	●	snags
Pileated Woodpecker						
Least Flycatcher						
Boreal Chickadee				●	●	snags
Swainson's Thrush			○	○	○	
Nashville Warbler		●	●	●		high level of light penetration, preferably with shallow undergrowth
Connecticut Warbler	○	○				nests in spruce bogs/tamarack fens with well developed understorey
White-throated Sparrow	○	○			○	numerous openings with low dense vegetation
Northern Flying Squirrel				○	○	snags
Southern Red-backed Vole		○	○	●	●	downed woody debris
Meadow Vole	○					fields, grassy meadows
Marten			○	●	●	snags, downed woody debris
Woodland Caribou (winter)						
Woodland Caribou (hab. rank)			○	○	○	
White-tailed Deer (forage)	○	○				
White-tailed Deer (cover)						
Moose (forage)	○	○				
Moose (cover)			○	○	○	

○ Used Habitat ● Preferred Habitat

Successional Relationships - Natural

This ecosite is characterized by a mixed jack pine - black spruce canopy. Jack pine is almost exclusively found in the canopy, whereas black spruce is distributed throughout the canopy, sub-canopy and sapling layers. White birch, trembling aspen and/or white spruce are often present in the upper two canopies as well as in the sapling layer. Total tree cover are high, and shrub and herb cover generally low. Stand ages range from 41 to 242 years with the majority of sites occurring between 50 to 100 years of age.

Total shrub cover is low, and ericaceous shrubs are ubiquitous (mainly *Vaccinium* spp., *Gaultheria hispidula*, *Ledum groenlandicum* and *Rosa acicularis*). *Ledum groenlandicum* is often present on moist sites and generally occurs at moderate to high cover. Tall shrubs are of relatively uncommon. Non-ericaceous shrubs and herbs occur with low frequency and/or cover. The forest floor is primarily covered by *Pleurozium schreberi* although *Dicranum polysetum*, *Ptilium crista-cristensis* and *Hylocomium splendens* are also frequent. Species richness, diversity and evenness are low compared to the other ecosites.

The successional trajectory indicates increased dominance by black spruce, in both the canopy and sub canopy layers. Like ES22, black spruce recruitment into the stand remains strong and total canopy cover does not declines over time. Recruitment of black spruce is initially contemporaneous with jack pine and then becomes gradual or episodic. Episodic recruitment usually follows low-intensity surface fire. This results in a dense, uneven-aged monodominant black spruce stand.

Some relict jack pine may occur in older stands. White birch which may show moderate to strong regeneration in more open canopy sites and/or in areas of windthrow, persists in some older stands. Balsam fir regenerates well in the understorey beginning at or about 30 years of age provided a seed source is nearby. However, balsam fir seldom reaches the canopy layer. A slight increase in tree level diversity occurs at older ages reflecting the higher frequency of white birch, trembling aspen and balsam fir.

It has been speculated that mixed jack pine and black spruce stands represent a successional stage towards fir-spruce dominance. However, regional data demonstrates that although balsam fir is often present in the sapling layer it seldom enters the canopy of older stands. Differential mortality of balsam fir on this ecosite may be attributable to the combined effects of low nutrient availability, ungulate herbivory, and spruce budworm infestation.

Tall and low shrub cover will decline over time after 100 years as canopy closure is maintained. Herb cover declines steadily. Moss species continue to dominate the forest floor. Total herb cover is generally less than that of shrubs and also declines, particularly in older stands.

Successional Relationships - Post-harvest

Response following harvest:

The presence of a viable black spruce or jack pine seed source from residuals or adjacent stands will contribute to the perpetuation of those species on this ecosite. Jack pine in the original stand will make the likelihood of jack pine ingress greater. An aspen component present in the original canopy is likely to be maintained through vegetative suckering while birch will be maintained through seed origin reproduction. Both hardwood species increase in abundance following harvest.

Ecosite 26 has a high probability for natural ingress of all three tree species. Full and 50 percent ingress are achieved approximately seven and three years after harvest, respectively.

A moderate probability exists for black spruce advance growth to occur in the understorey in the undisturbed stand. Stocking of black spruce and balsam fir in the sub-canopy or as advance growth in the understorey will be greatly reduced following canopy removal due to exposure, sunscald and increased droughtiness of the site.

Proliferation of herbs and low woody shrubs is common. Exposed feathermoss quickly dies following removal of the overstorey.

Response following harvest and mechanical site preparation:

Disturbance and mixing of the LFH with mineral soil will create suitable seedbed for black spruce and jack pine. If jack pine is present in the original stand, its presence in the future stand may be enhanced by scarification on the site.

Soil disturbance will stimulate the establishment and growth of woody shrubs and will stimulate hardwood suckering especially from aspen. Mechanical site preparation and the exposure or mixing of mineral and organic soils will greatly stimulate the establishment of grasses and wild raspberry. Retention of an intact forest floor condition will reduce non-crop species on site.

Response following harvest and prescribed fire:

Following fire, the growth of trembling aspen, ericaceous shrubs (blueberry) and herbs is stimulated. These species can quickly dominate the site within two years. Moderate to high intensity surface fires will be effective in reducing future competition from woody shrubs but will result in a less-than-favorable exposed mineral soil seedbed suitable for conifer establishment. Prescribed fire will destroy any black spruce or balsam fir advance growth and will usually girdle any seedling jack pine. Moderate to severe intensity surface fires will completely remove the surface organic horizons and kill any hardwood shrubs or aspen present on the cutover.

Site Productivity

Site Index by species and NWO FEC Soil Type

Site Index (breast height age 50 years)

Soil Type	Species		
	Sb	Pj	Po
S5	16.8	N/A	20.3
S6	12.8	17.3	19.3
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Black Spruce Advance Regeneration

	Vegetation Type	
	V31	V33
Stocking (%)	19	24
Stocking Range	0 – 55	0 – 95
Stems per ha	1000	2500

V31 and 33 are the characteristic vegetation types.

This ecosite is dominated by jack pine and black spruce with scattered stems of other species.

Where black spruce dominated the original stand, there is a moderate possibility of black spruce advance growth being present in numbers and distribution to adequately regenerate the site.

The number and distribution of black spruce advance growth on this ecosite is positively related to:

- basal area of black spruce in the original stand

and inversely related to:

- percent cover of herbaceous species
- percent cover of broadleaf litter
- percent canopy closure

Natural Ingress Probability and Density (ten years post-disturbance)

Seedbed Condition	Species and Height Class					
	Sb		Pj		Po	
	< 1.0	> 1.0	< 1.0	> 1.0	< 1.0	> 1.0
Duff	X ▒	X ░	X □	X ▓	L □	H ▒
Mineral Soil	Insufficient Data					
Burned	Insufficient Data					

Probability Class

V- < 21%
L- 21 - 40%
M- 41 - 60%
H- 61 - 80%
X- > 80%

Density Class

□ < 300
░ 300 - 1000
▒ 1001 - 5000
▓ 5001 - 10000
■ > 10000

- Natural regeneration abundance, species dominance and timing are very similar to ES25.
- For all three species, full and 50 percent ingress are achieved approximately seven and three years after disturbance, respectively.

Critical Comments

- Low to moderate competition may be expected from white birch and aspen (where it exists in the original stand). Stands may be herb- and shrub-rich where silt content is high or gaps exist in the overstorey canopy.
- Labrador-tea may be locally abundant on toe slopes and in depressions where soil moisture conditions are enhanced. Ericaceous woody shrubs have the potential to adversely affect the germination, survival and growth of young black spruce seedlings.
- Exposure of surface mineral soil may lead to soil baking and/or frost heaving of planted seedlings.
- Ecosites supporting V30, V31, V32, V33, are moderately susceptible to spruce budworm infestation.
- Natural regeneration of black spruce limited by available local seed supply and lack of suitable supply and duration of receptive seedbed and smothering from hardwood litter.

Site Characteristics, Limitations and Hazard Potential

Characteristics								Limitations				Hazard Potential			
LFH Layer	Soil Texture	Depth to Bedrock	Stoniness	Moisture Regime	Terrain	Competition	Windthrow	Frost Heaving	Drought/Desiccation	Seasonal Flooding	Compaction	Rutting	Soil Erosion	Biomass & Nutrient Removal	Silvicultural Activities
1	1,3			4	3						4	4	1,3		Harvesting
1,2	1,3			4	3	1		1			4	4	1,3		Renewal
	1,3					1									Tending

Footnotes:

1. Disturbance of the forest floor on fine textured soils will promote non-crop vegetation and increase the potential for erosion and frost heaving.
2. LFH layer is a poor seedbed.
3. Soil erosion hazard increases with silt content. Hazard is moderate to high on slopes > ten percent.
4. Fine textured soils are susceptible to compaction and rutting when saturated during the frost free period.

Opportunities

- High levels of jack pine and black spruce ingress after disturbance, coupled with moderate levels of black spruce advance growth make this ecosite an attractive candidate for natural regeneration treatments.
- Site quality for aspen growth and wood quality enhanced on this site, expecially where stone content approaches 30 percent and soils are calcareous.
- Creating receptive seedbed through fire or mechanical site preparation is necessary for natural or artificial seeding of pine or spruce. Select phases of this ecosite with lower silt contents to minimize competition for seeding treatments.
- Low intensity scarification to scatter and align jack pine slash will enhance natural regeneration from seed on this low to moderate competition site.
- Jack pine and black spruce seed trees (minimum 20/ha) in conjunction with prescribed fire offers a cost-effective regeneration strategy on these sites. Target the less competitive sites for this treatment.

Silvicultural Intensity Considerations

Species Objective	Site Productivity	Degree of Effort to Reach Free-to-grow
Black spruce	1	3
Jack pine	1	2
Aspen	1	1

Site Productivity - Site Productivity class (prime land productivity class) based upon height of dominant trees at age 50 years (breast height).

Degree of Effort

1 = Extensive
2 = Basic
3 = Intensive
4 = Highly Intensive

Silvicultural Interpretations for the Establishment of Black Spruce

Silvicultural System **• Harvest Method**		**Comments**
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	R	An assessment of seedbed quality and the quality and quantity of black spruce parent trees in the leave strip is necessary to determine potential of this treatment. Strip width should be less than 40 m due to soil moisture regime. This cutting technique may also be prescribed to meet other management objectives.
- Patch	R	An assessment of seedbed quality and the quality and quantity of black spruce parent trees in the leave patch is necessary to determine potential of this treatment. Careful consideration must be given to the size and configuration of patches due to soil moisture regime. This cutting technique may also be prescribed to meet other management objectives.
- Seed-tree	R	Group seed tree is the most commonly used technique. Individual tree seed tree to be used only in conjunction with prescribed fire. Ensure there is adequate distribution of black spruce in the portion of the stand where seed tree system is being prescribed.
Shelterwood	NR	Black spruce is mid-tolerant and susceptible to windthrow after thinning of closed canopy stands.
Selection	NR	See Shelterwood comment.
Logging Method		Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season.
Full-tree	R	
Tree-length	R	Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	R	See Tree-length comment.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Black Spruce (con't)

RenewalTreatments	Comments	
Site Preparation		Low to moderate competition on this site. Aspen and white birch may be locally abundant.
• Mechanical	R	Techniques, timing and sequence of treatments should be carefully considered. Minimize mineral soil exposure on clays to reduce the incidence of soil baking and/or frost heaving, and to prevent increased competition from non-crop vegetation on a mixed mineral/organic microsite. Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season.
• Chemical	R	Shrub and herb poor. Chemical site preparation is generally not required.
• Prescribed Burn	R	Severity of burn will affect vegetation response.
Regeneration • Natural - Advance Growth	R	Moderate levels of advance growth. May require supplemental artificial regeneration.
- Seed	NR	Low levels of black spruce ingress.
- Vegetative (coppice)	NR	Black spruce does not coppice.
• Artificial - Planting	R	Plant close to the mineral/organic interface.
- Seeding	NR	Reduced seeding success on clay soils. Potential for seasonal drought will limit success.
- Scarification	NR	Site conditions imply low levels of black spruce ingress.
Tending Treatments		
Cleaning		Low to moderate competition on this site and cleaning is generally not required.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing will be beneficial where black spruce density is high from seeding or advance growth.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine

Silvicultural System **• Harvest Method**	**Comments**	
Clearcut		
• Harvest Method		
- Conventional	R	
- Strip/Block	R	Residual stand will not contribute seed of sufficient quantity or genetic quality. However, this cutting technique may be prescribed to meet other management objectives.
- Patch	R	See Strip/Block comment.
- Seed-tree	CR	Jack pine seed tree systems are only to be used in conjunction with a post-harvest prescribed burn which creates 50% net mineral soil exposure well distributed across the site.
Shelterwood	NR	Jack pine is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season.
Full-tree	R	
Tree-length	R	Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	R	See Tree-length comment.
Renewal Treatments		
Site Preparation		Low to moderate competition on this site. Aspen and white birch may be locally abundant.
• Mechanical	CR	Techniques, timing and sequencing of treatments should be carefully considered. Minimize mineral soil exposure on clays to reduce the incidence of soil baking and/or frost heaving, and to prevent increased competition from non-crop vegetation on a mixed mineral/organic microsite. Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season.
• Chemical	R	Shrub and herb poor. Chemical site preparation is generally not required.
• Prescribed Burn	R	Severity of burn will affect vegetation response. Prescribed burn is required when using seed tree silvicultural system.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine (con't)

Renewal Treatments	Comments	
Regeneration • Natural - Advance Growth	NR	Jack pine does not regenerate under a closed canopy.
- Seed	R	High levels of jack pine ingress.
- Vegetative (coppice)	NR	Jack pine does not coppice.
• Artificial - Planting	R	Plant close to the mineral/organic interface.
- Seeding	R	Good distribution of mineral soil seedbeds will contribute to success.
- Scarification	R	High levels of jack pine ingress. Excessive displacement of the organic layer will create a favourable environment for establishing of windborne seed and seedbank species.
Tending Treatments		
Cleaning		Low to moderate competition on this site and cleaning is generally not required.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing will be beneficial where jack pine density is high from natural or direct seeding.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Aspen

Silvicultural System **• Harvest Method**		**Comments**
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	CR	Strips should be at least 20 m wide to warm the soil and stimulate suckering. Strip cutting can also be prescribed to meet other management objectives.
- Patch	CR	Openings 0.4 ha in size are the minimum acceptable to stimulate aspen suckering. Patch cutting can also be prescribed to meet other management objectives.
- Seed-tree	NR	Leaving live aspen will reduce suckering.
Shelterwood	NR	Aspen is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season.
Full-tree	R	
Tree-length	R	Slash remaining on the site will reduce soil temperature and sucker production.
Cut-to-length/Shortwood	R	See Tree-length comment. Concentration of slash in rows by single grip harvesters will create an uneven distribution of aspen suckers.
Renewal Treatments		
Site Preparation • Mechanical	NR	See Scarification (Section II, Book I).
• Chemical	R	Chemical site preparation may be used on sites where the residual overstorey will negatively affect root suckering. 2,4-D is recommended since it will remove the overstorey without damaging the aspen root systems.
• Prescribed Burn	R	

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

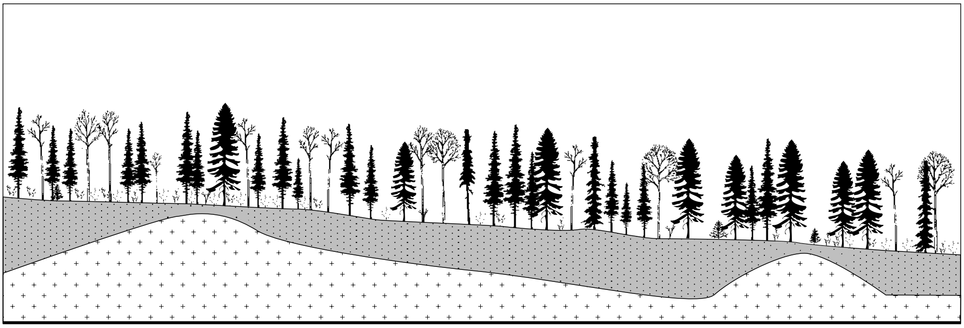
Silvicultural Interpretations for the Establishment of Aspen (con't)

Renewal Treatments		**Comments**
Regeneration • Natural - Advance Growth	NR	Aspen does not regenerate under a closed canopy.
- Seed	NR	Aspen regeneration from seed is highly variable.
- Vegetative (coppice)	R	
• Artificial - Planting	NR	Insufficient data and/or field experience exist to recommend this technique. Planting of aspen seedlings may be considered when existing aspen has deteriorated to a point where vegetative regeneration is unlikely or undesirable.
- Seeding	NR	Insufficient data and/or field experience exist to recommend this technique.
- Scarification	R	
Tending Treatments		
Cleaning		Low to moderate competition on this site. High initial densities and rapid early growth of aspen suckers will ensure their successful renewal.
• Manual	NR	
• Mechanical	NR	
• Chemical - Ground	NR	
- Aerial	NR	
Spacing	R	Site quality and timing is critical for the success of this treatment.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

ES 27

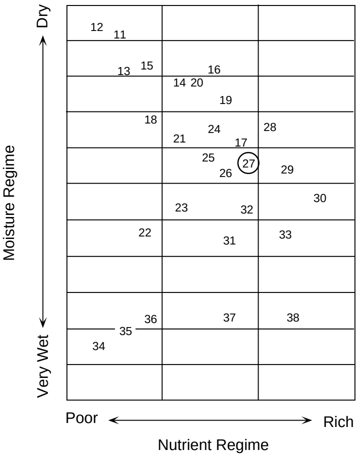
Fir–Spruce Mixedwood: Fresh, Silty–Fine Loamy Soil



approximately 250 m

General Description

Dominated by balsam fir, black spruce and white spruce with mixtures of trembling aspen and white birch. Typically shrub- and herb-rich. Soils are fresh, well to moderately well drained, silty to fine loamy. Occurring predominantly on lacustrine and glaciofluvial parent material. Ground cover consists of broadleaf litter, conifer litter, feathermoss and wood.



Soil Types

S4, S5, SS7

Mode of Deposition

lacustrine, glaciofluvial

Humus Form

fibrimor, humifibrimor

Overstorey

balsam fir, white spruce, black spruce, trembling aspen, white birch

Shrubs/Trees (<10 m)

Acer spicatum, Corylus cornuta, Diervilla lonicera, Lonicera canadensis, Rubus pubescens, Linnaea borealis, balsam fir, white birch, trembling aspen

Herbs and Graminoids

Aster macrophyllus, Streptopus roseus, Aralia nudicaulis, Viola renifolia, Galium triflorum, Clintonia borealis, Trientalis borealis, Maianthemum canadense, Cornus canadensis

Mosses and Lichens

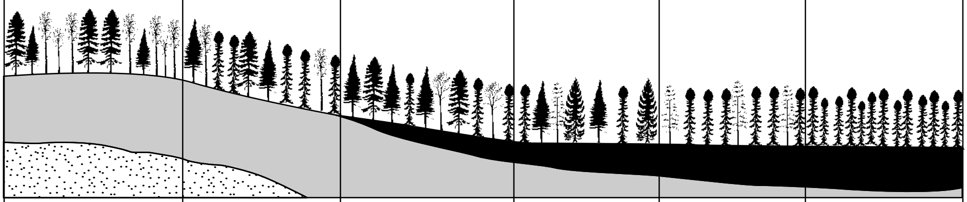
Pleurozium schreberi, Ptilium crista-castrensis, Hylocomium splendens, Rhytidiadelphus triquetrus

Comments

Vegetation cover is relatively uniform, consisting of characteristic V-types V14, V15 and V16. Expect local variation to V7, V8, V9, V24 and V25 where hardwood pockets are encountered. May also contain pockets of V12 and V13 in Site Regions 4S, 4W and 5S. Soils are typically deep, but may contain inclusions of SS7. Topography is often gently rolling.

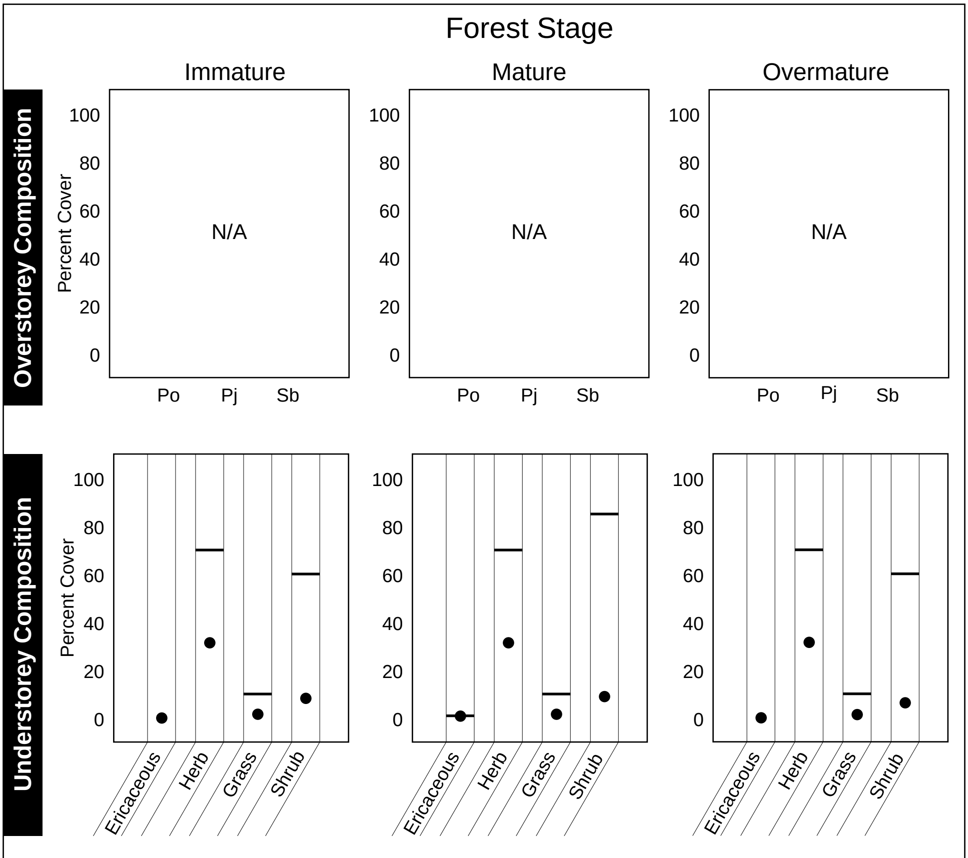
Typical Landscape Associations

Typical Ecosite Sequence on Deep Silty to Clayey Glaciolacustrine Material



Po-Sw (Bf)	Sb-Bf-Sw (Po)	Bf-Sw (Pb-Sb)	Ce-Bf (Sb-Ta)	Sb-Ta	Sb
ES29 Hardwood-Fir-Spruce Mixedwood: Fresh, Loamy-Clayey Soil	ES27 Fir-Spruce Mixedwood: Fresh, Silty-Fine Loamy Soil	ES32 Fir-Spruce Mixedwod: Moist, Silty-Clayey Soil	ES37 Rich Swamp: Cedar (Other Conifer): Organic Soil	ES36 Intermediate Swamp: Black Spruce (Tamarack): Organic Soil	ES35 Poor Swamp: Black Spruce: Organic Soil
V8 Trembling Aspen (White Birch)/ Mountain Maple	V16 Balsam Fir-White Spruce Mixedwood/ Feathermoss	V14 Balsam Fir Mixedwood	V22 Cedar (inc. Mixedwood)/ Speckled Alder/ Sphagnum	V23 Tamarack (Black Spruce)/ Speckled Alder/ Labrador-tea	V37 Black Spruce/ Ericaceous Shrub/ Sphagnum
S5 Fresh/ Fine Loamy	S6 Fresh/Clayey	S10 Moist/Fine Loamy-Clayey	S12F Wet/Organic (Feathermoss)	S12S Wet/Organic (Sphagnum)	S12S Wet/Organic (Sphagnum)
Fresh	Fresh	Moist	Wet	Wet	Wet

Site Structure and Composition



Advance Growth

Forest Stage

	Immature		Mature		Overmature	
	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)
Sb	1320	N/A	1948	N/A	2270	N/A
Bf	4690	N/A	2155	N/A	2250	N/A

Seedbed

	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen
	0	12	20	68	0	0	12	20	68	0	0	12	20	68	0

Coarse Woody Debris

	Logs	Debris	Logs	Debris	Logs	Debris
	N/A	N/A	N/A	N/A	N/A	N/A

Vegetation and Soil Type Relationships

(number of plots with defined combinations)

Balsam Fir Mixedwood 14	White Spruce Mixedwood 15	Balsam Fir – White Spruce Mixedwood / Feathermoss 16	Trembling Aspen – Balsam Fir / Balsam Fir Shrub 7	Trembling Aspen (White Birch) / Mountain Maple 8		
▨	□	□	■	■		
6	4	1	5	4	▨	S4 – Fresh / Silty - Silt Loamy
1	2			2	▨	S5 – Fresh / Fine Loamy
1				1	□	SS7– Shallow – Moderately Deep / Silty – Fine Loamy – Clayey

Description of Soil and Vegetation

▨ Characteristic Common

■ Common Inclusions

□ Characteristic Uncommon

Selected Species Habitat Use

Species	Forest Stage: Pre-sapling	Sapling	Immature	Mature	Overmature	Special Habitat Preferences
Spruce Grouse						
Great Grey Owl						
Black-backed Woodpecker						
Pileated Woodpecker						
Least Flycatcher				○	○	often found near open spaces (edge, riparian)
Boreal Chickadee				○	○	snags
Swainson's Thrush			○	○	○	
Nashville Warbler		●	●	●		high level of light penetration, preferably with shallow undergrowth
Connecticut Warbler						
White-throated Sparrow	○	○			○	numerous openings with low dense vegetation
Northern Flying Squirrel				○	○	snags
Southern Red-backed Vole		○	○	○	○	downed woody debris
Meadow Vole	●					fields, grassy meadows
Marten			○	●	●	snags, downed woody debris
Woodland Caribou (winter)						
Woodland Caribou (hab. rank)				○	○	
White-tailed Deer (forage)	●	●			●	
White-tailed Deer (cover)			○	●	●	
Moose (forage)	○	○				
Moose (cover)			○	○	○	

○ Used Habitat ● Preferred Habitat

Successional Relationships - Natural

These stands are often dominated by balsam fir, white spruce and black spruce in the canopy with mixtures of trembling aspen and white birch. Balsam fir is the most frequent and abundant species and may occasionally occur as pure stands. Total tree cover remains high during much of this stands existence. This ecosite is typically shrub and herb rich. The tall and low shrub layers are usually dominated by balsam fir, *Acer spicatum, Corylus cornuta* and *Diervilla lonicera*. White birch, trembling aspen and black spruce can also occur in the sapling layer on this ecosite. Stand age varies from 43 to 177 years with the majority of sites occurring in the 70 to 100 year range.

Tall shrubs are frequent and occur at moderate to high cover in most stands; ericaceous shrubs are typically uncommon. The low shrub, *Diervilla lonicera*, is commonly encountered throughout the life of this stand. *Rosa acicularis* and *Ribes* spp. are common but not abundant. The herb layer is floristically rich and total cover can be quite high (>30 percent) although any one individual species cover is low. Moss species richness is also high. *Pleurozium schreberi* is the most ubiquitous and occurs at moderate cover.

In the absence of the spruce budworm, the overall successional trajectory for these stands is toward a more open, uneven-aged canopy of mixed species composition. The hardwood component is slowly replaced by coniferous species, particularly, white spruce and balsam fir. The oldest stands are uneven-aged and show strong conifer regeneration in the sub-canopy and seedling layers. Black spruce regeneration declines over time, suggesting that it may eventually disappear from many of these stands. The canopy cover decreases as sub-canopy cover increases. At extended rotations, white spruce will form a super-canopy with a main canopy of balsam fir, white birch and black spruce. On steep slopes and on calcareous substrates, eastern white cedar may also be present in large numbers in the main canopy. White spruce rarely forms pure stands. Tall shrub frequency and cover (particularly *Acer spicatum* and *Corylus cornuta*) increase with age. These stands become essentially self-regenerating. Species richness, diversity and evenness remain high in older stands on this ecosite.

Balsam fir is favored by gap creation in previous trembling aspen dominated mixed woods. At even older ages (140 years) and in the absence of fire, sparse regeneration of the hardwood components results in an increasing dominance by woody shrubs and shade tolerant conifers such as balsam fir, The balsam fir sub-canopy component in aspen dominated stands eventually grows through into the main canopy. Species richness, diversity and evenness increase marginally over time. Mean tree species richness, diversity and evenness all increase over time, indicating the increasingly ‘mixed’ nature of the canopy-sub-canopy as stands age.

The presence of spruce budworm on the landscape is a critical component in directing succession of these balsam fir dominated ecosystems. Periodic infestations of spruce budworm can kill 70 to 100 percent of all balsam fir stems and between ten to 40 percent of all white spruce stems in the overstorey. This is provided that defoliation extends through five or more years. Spruce budworm outbreaks tend to be self-propagating once initiated with outbreak severity positively correlated with the proportion of balsam fir in the canopy. Trees that do survive defoliation usually become weakened and are susceptible to root rot and windthrow.

Succession following spruce budworm infestation is different than that following fire because the budworm does not usually eliminate all balsam fir stems on the site. Canopy removal releases balsam fir and white/black spruce seedlings in the understorey often favoring the spruce component. The removal of the canopy may also favor the regeneration of more shade tolerant woody tall shrubs such as *Acer spicatum* and *Corylus cornuta* which exist in the understorey. These woody shrubs often suppress or reduce any further balsam fir regeneration on the forest floor.

Successional Relationships - Post-harvest

Response following harvest:

Post-harvest successional patterns are extremely complex to predict due to the combined interaction of soil/site conditions, original stand conditions, season of harvest and severity and duration of the harvest activity. Following harvest, aspen and white birch increase in density and dominance due to rapid sprouting and suckering from any remaining stems. Removal of the overstorey results in the reproduction and growth of wood shrubs and the herbaceous layer. Balsam fir seedlings are released and new seedbeds for balsam fir are created by disturbance to the mineral floor.

The protection of conifer advance growth often will result in stand development patterns and compositions similar to that following wildfire; however, the prevalent species in the post-logging cover type is balsam fir due to lack of a spruce seed source and a sufficient quantity and quality of receptive seedbed for white and black spruce. This ecosite has a low probability of sufficient number and distribution of black spruce advance growth to form a significant component of the new stand. Careful logging techniques will result in a mixedwood stand condition where balsam fir is a significant component.

Response following harvest and mechanical site preparation:

Following harvest, aspen and white birch increase in density and dominance due to rapid sprouting and suckering. Removal of the overstorey results in the reproduction and growth of wood shrubs and the herbaceous layer. Mechanical site preparation stimulates hardwood suckering and sprouting of shrubs - especially *Corylus cornuta* by stimulating reproduction from underground sprouts. Disc trenching, blading and use of a brush blade will reduce the cover and abundance of the *Corylus cornuta* but will have minimal effect on *Acer spicatum*. However, mechanical site preparation on these sites is very effective in reducing the proportion of balsam fir in the new stand arising from advance growth present at time of harvest.

The largest differences between the succession of the natural forest and in new conifer plantations is in the hardwood/softwood densities, the mortality rates and the balsam fir content within the stands. In natural stands there can be in excess of 3500 stems per hectare of balsam fir while plantations contain an average of only 500 stems per hectare. Balsam fir from advance growth rarely accounted for more than 15 percent of overstorey density in plantations.

Response following harvest and prescribed fire:

High intensity severe prescribed burns will effectively reduce the density and dominance of aspen and white birch in the regeneration phase as well as *Acer spicatum* and *Corylus cornuta*. Low intensity prescribed fire will stimulate the regeneration of the *Corylus cornuta* but repeat summer fires will exhaust stored food reserves and reduce its ability to re-sprout. Prescribed fire on this site generally creates exceptional seedbed conditions for a variety of grass species and wild raspberry which colonize via rhizomes and seeds. Prescribed fire of existing grass will stimulate seeding. Prescribed fire is successful in eliminating balsam fir regeneration and advance growth; the degree of impact is related to severity and intensity of the burn.

Site Productivity

Site Index by species and NWO FEC Soil Type

Site Index (breast height age 50 years)

Soil Type	Species		
	Sb	Pj	Po
S4	13.8	21.2	21.4
S5	16.8	N/A	20.3
SS7	13.7	14.2	22.2

Black Spruce Advance Regeneration

	Vegetation Type		
	V14	V15	V16
Stocking (%)	N/A	N/A	N/A
Stocking Range	N/A	N/A	N/A
Stems per ha	N/A	N/A	N/A

V14 is the characteristic vegetation type with V15 and V16 as common inclusions.

Balsam fir, white spruce, and black spruce dominate the ecosite with trembling aspen and white birch present in varying proportions.

Mixedwood vegetation types V14, V15 and V16 were not surveyed for black spruce advance growth. Due to the low density of black spruce in the canopy, black spruce advance growth is generally assumed to be low.

The number and distribution of black spruce advance growth on this ecosite is positively related to:

- basal area of black spruce in the original stand
- per cent cover of sphagnum moss or Labrador-tea

and inversely related to:

- percent cover of herbaceous species
- percent cover of broadleaf litter
- percent canopy closure

Natural Ingress Probability and Density (ten years post-disturbance)

No information available

Critical Comments

- High levels of woody shrub and hardwood tree competition from mountain maple, white birch, aspen, beaked hazel and balsam fir on V14, V15, and V16. *Calamagrostis canadensis* is often abundant following harvest when excessive amounts of soil disturbance are created.
- Most tree species will be highly susceptible to *Armillaria* spp. on this site. Balsam fir, white spruce and black spruce may also be susceptible to *Inonotus tomentosus* on the same sites where *Armillaria* spp. occurs.
- Stands are vulnerable to spruce budworm if the proportion of balsam fir and white spruce in the stands exceeds 20 percent of the total crown volume.
- Natural regeneration of black spruce and jack pine limited by available local seed supply and lack of suitable supply and duration of receptive seedbed and smothering from hardwood litter.
- Exposure of surface mineral soil may lead to soil baking and/or frost heaving of planted seedlings.

Site Characteristics, Limitations and Hazard Potential

Characteristics							Limitations				Hazard Potential				
LFH Layer	Soil Texture	Depth to Bedrock	Stoniness	Moisture Regime	Terrain	Competition	Windthrow	Frost Heaving	Drought/Desiccation	Seasonal Flooding	Compaction	Rutting	Soil Erosion	Biomass & Nutrient Removal	Silvicultural Activities
1	1,3			4	3						4	4	1,3		Harvesting
1,2	1,3			4	3	1,5		1			4	4	1,3		Renewal
	1,3					1,5									Tending

Footnotes:

1. Disturbance of the forest floor on fine textured soils will promote non-crop vegetation and increase the potential for erosion and frost heaving.
2. LFH layer is a poor seedbed.
3. Soil erosion hazard increases with silt content. Hazard is moderate to high on slopes greater than ten percent.
4. Fine textured soils are susceptible to compaction and rutting when saturated during the frost free period.
5. Very high competition with mountain maple, beaked hazel, white birch, aspen, balsam fir and blue-joint grass as the principle competitors.

Opportunities

- This ecosite can also be managed to support forests dominated by balsam fir, white birch, and/or white spruce.
- Site quality for aspen growth and wood quality enhanced on this site, expecially where stone content approaches 30 percent and soils are calcareous.
- White spruce and black spruce seed trees, combined with site preparation for mineral soil exposure, can augment conifer regeneration levels.
- Use prescribed fire after harvest to eliminate dense balsam fir advance growth and create plantable spots or stimulate aspen suckering.
- Browse production potential is high, both before and after harvest.
- This ecosite may provide winter shelter for moose depending upon the habitat mosaic.
- Stands associated with this ecosite have a high degree of structural diversity contributing to their importance as potential habitat for small mammals, furbearers and a large number of songbirds.
- Soil active herbicides generally available for use on fine textured soils.

Silvicultural Intensity Considerations

Species Objective	Site Productivity	Degree of Effort to Reach Free-to-grow
Black spruce	1	3
Jack pine	1	3
Aspen	1	1

Site Productivity - Site Productivity class (prime land productivity class) based upon height of dominant trees at age 50 years (breast height).

Degree of Effort

1 = Extensive
2 = Basic
3 = Intensive
4 = Highly Intensive

Silvicultural Interpretations for the Establishment of Black Spruce

Silvicultural System • Harvest Method	Comments	
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	R	Residual stand will not contribute seed of sufficient quantity. However, this cutting technique may be prescribed to meet other management objectives.
- Patch	R	See Strip/Block comment.
- Seed-tree	NR	Potential for natural seeding is very low due to infrequent occurrence of black spruce in the original stand and lack of receptive seedbed. Potential competition limits natural regeneration.
Shelterwood	NR	Black spruce is mid-tolerant and susceptible to windthrow after thinning of closed canopy stands.
Selection	NR	See Shelterwood comment.
Logging Method		Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season.
Full-tree	R	
Tree-length	R	Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	R	See Tree-length comment.
Renewal Treatments		
Site Preparation		Very high competition on this site.
• Mechanical	R	Techniques, timing and sequencing of treatments should be carefully considered. Minimize mineral soil exposure on clays to reduce the incidence of soil baking and/or frost heaving, and to prevent increased competition from non-crop vegetation on a mixed mineral/organic microsite. Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season. Chemi-mechanical site preparation should be considered. Potential for standing dead and down woody debris resulting from repeat spruce budworm infestation is high and will affect equipment operability and effectiveness.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Black Spruce (con't)

Renewal Treatments	Comments	
• Chemical	R	Some herbicide-resistant non-crop species may occur on this site.
• Prescribed Burn	R	Severity of burn will affect vegetation response. Fire will be beneficial for reduction of balsam fir competition, standing dead and down woody debris and associated heavy slash loads.
Regeneration • Natural - Advance Growth	NR	Insufficient data exist. Vegetation types imply low levels of black spruce advance growth.
- Seed	NR	Insufficient data exist. Site conditions imply low levels of black spruce ingress.
- Vegetative (coppice)	NR	Black spruce does not coppice.
• Artificial - Planting	R	Plant close to the mineral/organic interface.
- Seeding	NR	Smothering of seedbeds with hardwood litter will limit success. In addition, the distribution, abundance and vigour of non-crop vegetation precludes the survival and growth of seed origin black spruce.
- Scarification	NR	Insufficient data exist. Site conditions imply low levels of black spruce ingress.
Tending Treatments		
Cleaning		Very high competition on this site.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing is usually not necessary since black spruce natural regeneration is minimal.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine

Silvicultural System **• Harvest Method**		**Comments**
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	R	Residual stand will not contribute seed of sufficient quantity or genetic quality. However, this cutting technique may be prescribed to meet other management objectives.
- Patch	R	See Strip/Block comment.
- Seed-tree	NR	Potential for natural seeding is very low due to infrequent occurrence of jack pine in the original stand.
Shelterwood	NR	Jack pine is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season.
Full-tree	R	
Tree-length	R	Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	R	See Tree-length comment.
Renewal Treatments		
Site Preparation		Very high competition on this site.
• Mechanical	R	Techniques, timing and sequencing of treatments should be carefully considered. Minimize mineral soil exposure on clays to reduce the incidence of soil baking and/or frost heaving, and to prevent increased competition from non-crop vegetation on a mixed mineral/organic microsite. Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season. Chemi-mechanical site preparation should be considered. Potential for standing dead and down woody debris resulting from repeat spruce budworm infestation is high and will affect equipment operability and effectiveness.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine (con't)

Renewal Treatments	Comments	
• Chemical	R	Some herbicide-resistant non-crop species may occur on this site.
• Prescribed Burn	R	Severity of burn will affect vegetation response. Fire will be beneficial for reduction of balsam fir competition, standing dead and down woody debris and associated heavy slash loads.
Regeneration • Natural - Advance Growth	NR	Jack pine does not regenerate under a closed canopy.
- Seed	NR	Potential for natural seeding is very low due to infrequent occurrence of jack pine in the original stand.
-Vegetative (coppice)	NR	Jack pine does not coppice.
• Artificial - Planting	R	Plant close to the mineral/organic interface.
- Seeding	NR	Smothering of seedbeds with hardwood litter will limit success. In addition, the distribution, abundance and vigour of non-crop vegetation precludes the survival and growth of seed origin jack pine.
- Scarification	NR	Cone loading is low due to low density of jack pine in the original stand. Cone scattering will give variable results.
Tending Treatments		
Cleaning		Very high competition on this site.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing is usually not necessary since jack pine natural regeneration is minimal.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Aspen

Silvicultural System **• Harvest Method**	**Comments**	
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	R	Strip width should be at least 20 m to warm the soil and stimulate suckering. Strip cutting can also be prescribed to meet other management objectives.
- Patch	R	Openings 0.4 ha in size are the minimum acceptable to stimulate aspen suckering. Patch cutting can also be prescribed to meet other management objectives.
- Seed-tree	NR	Leaving live aspen will reduce suckering.
Shelterwood	NR	Aspen is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season.
Full-tree	R	
Tree-length	R	Slash remaining on the site will reduce soil temperature and sucker production.
Cut-to-length/Shortwood	R	See Tree-length comment. Concentration of slash in rows by single grip harvesters will create an uneven distribution of aspen suckers.

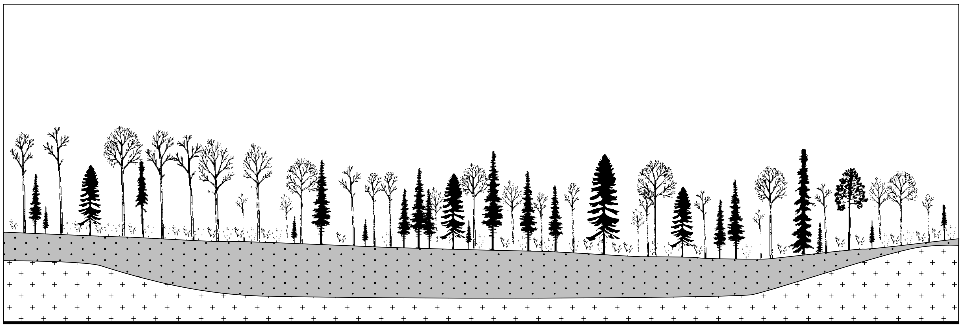
R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Aspen (con't)

Renewal Treatments	Comments	
Site Preparation • Mechanical	NR	See Scarification (Section II, Book I).
• Chemical	R	Chemical site preparation may be used on sites where the residual overstorey will negatively affect root suckering. 2,4-D is recommended since it will remove the overstorey without damaging the aspen root systems.
• Prescribed Burn	R	
Regeneration • Natural - Advance Growth	NR	Aspen does not regenerate under a closed canopy.
- Seed	NR	Aspen regeneration from seed is highly variable.
- Vegetative (coppice)	R	
• Artificial - Planting	NR	Insufficient data and/or field experience exist to recommend this technique. Planting of aspen seedlings may be considered when existing aspen has deteriorated to a point where vegetative regeneration is unlikely or undesirable.
- Seeding	NR	Insufficient data and/or field experience exist to recommend this technique.
- Scarification	R	
Tending Treatments		
Cleaning		Very high competition on this site. High initial densities and rapid early growth of aspen suckers will ensure their successful renewal.
• Manual	NR	
• Mechanical	NR	
• Chemical - Ground	NR	
- Aerial	NR	
Spacing	R	Site quality and timing is critical for the success of this treatment.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

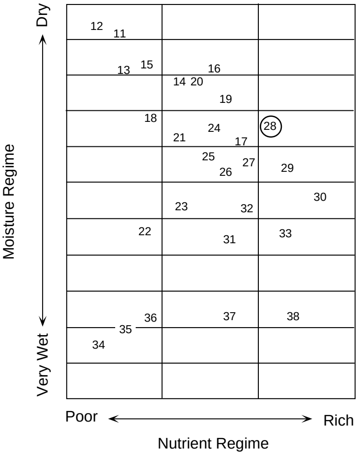
ES 28 Hardwood–Fir–Spruce Mixedwood: Fresh, Silty Soil



approximately 250 m

General Description

Dominated by trembling aspen and white birch with occasional occurrences of balsam fir, black spruce, jack pine and white spruce. Deciduous tree component exceeds 50% of the canopy. Shrub- and herb-rich. Soils fresh, well to moderately well drained silt or silt loam. Developed on lacustrine and glaciofluvial parent material. Ground cover consists of broadleaf litter, conifer litter, feathermoss and wood.



Soil Types
S4, SS7

Mode of Deposition
lacustrine, glaciofluvial

Humus Form
fibrimor, humifibrimor

Overstorey
trembling aspen, balsam fir, white birch, white spruce, jack pine, black spruce

Shrubs/Trees (<10 m)
Acer spicatum, Corylus cornuta, Diervilla lonicera, Lonicera canadensis, Linnaea borealis, Rubus pubescens, Alnus viridis, Vaccinium spp., Rosa acicularis, balsam fir, white spruce, *Sorbus decora,* white birch, trembling aspen

Herbs and Graminoids
Aster macrophyllus, Mitella nuda, Streptopus roseus, Aralia nudicaulis, Viola renifolia, Galium triflorum, Clintonia borealis, Trientalis borealis, Maianthemum canadense, Cornus canadensis, Actaea rubra, Lycopodium spp.

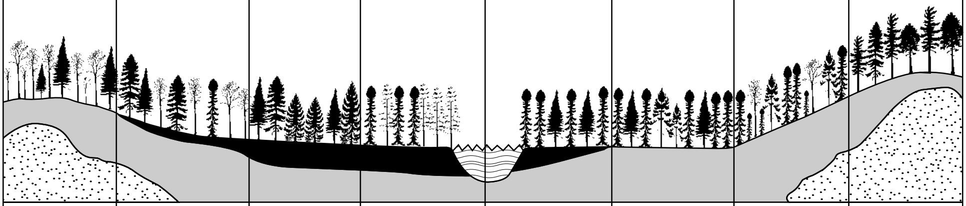
Mosses and Lichens
Pleurozium schreberi, Ptilium crista-castrensis, Hylocomium splendens, Rhytidiadelphus triquetrus

Comments

Extremely variable and productive ecosite. Characteristic V-types include V4, V5, V6, V7, V8, V9, V10 and V11, with some or all V-types being present on one site. Expect grading to V14 and V15 in patches with more abundant conifer cover. Landforms range from gently rolling to level terrain.

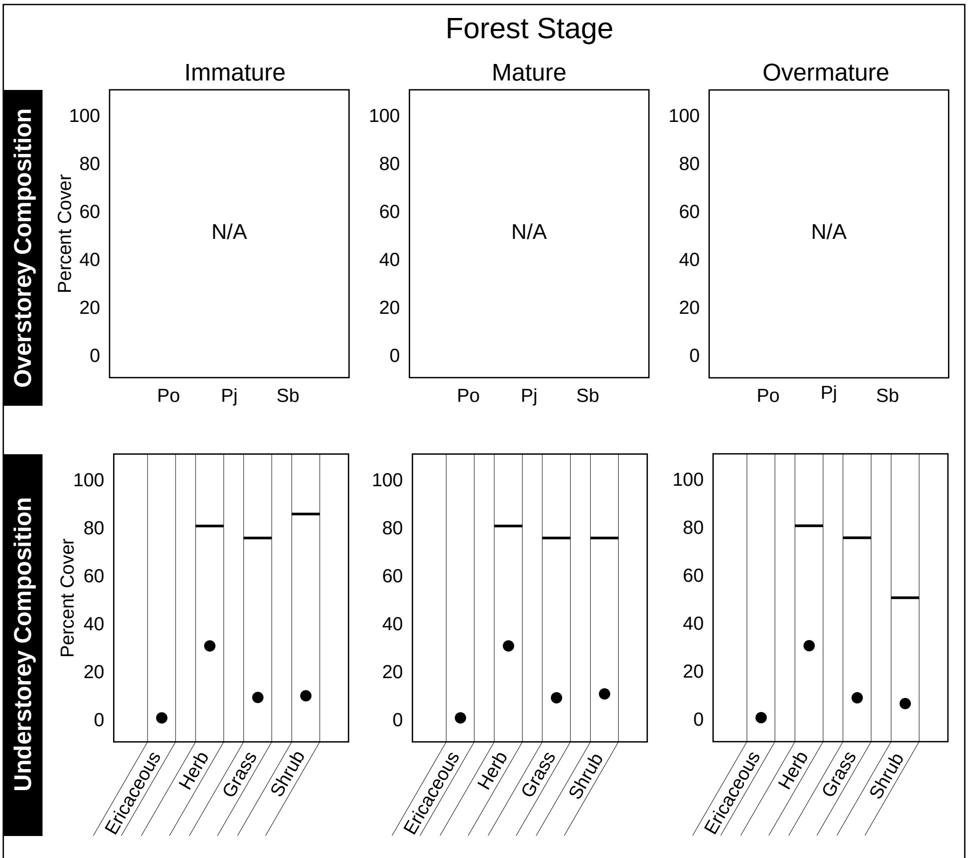
Typical Landscape Associations

Typical Ecosite Sequence on Silty to Clayey Glaciolacustrine and Alluvial Material



Po (Bw-Bf)	Po-Sw-Bw (Sb-Bf)	Ce-Bf-Sw	Ta-Sb	Sb (Bf)	Sb (Bf-Pj)	Sb-Pj (Po-Bw)	Pw-Pr (Bw)
ES28 Hardwood-Fir-Spruce Mixedwood: Fresh, Silty Soil	ES33 Hardwood-Fir-Spruce Mixedwood: Moist, Silty-Clayey Soil	ES37 Rich Swamp: Cedar (Other Conifer): Organic Soil	ES36 Intermediate Swamp: Black Spruce (Tamarack): Organic Soil	ES31 Spruce-Pine/ Feathermoss: Moist, Silty-Clayey Soil	ES25 Pine-Spruce/ Feathermoss: Fresh, Silty Soil	ES26 Spruce-Pine/ Feathermoss: Fresh, Fine Loamy-Clayey Soil	ES24 Red Pine-White Pine: Fresh, Fine Loamy Soil
V5 Aspen Hardwood	V9 Trembling Aspen Mixedwood	V21 Cedar (inc. Mixedwood)/ Mountain Maple	V23 Tamarack (Black Spruce)/ Speckled Alder/ Labrador-tea	V34 Black Spruce/ Labrador-tea/ Feathermoss (Sphagnum)	V31 Black Spruce-Jack Pine/ Tall Shrub/ Feathermoss	V32 Jack Pine-Black Spruce/ Ericaceous Shrub/ Feathermoss	V26 White Pine Conifer
S4 Fresh/Silty-Silt Loamy	S9 Moist/Silty-Silt Loamy	S12F Wet/Organic (Feathermoss)	S12S Wet/Organic (Sphagnum)	S10 Moist/Fine Loamy-Clayey	S4 Fresh/Silty-Silt Loamy	S5 Fresh/Fine Loamy	SS7 Moist/Sandy
Fresh	Moist	Wet	Wet	Moist	Fresh	Fresh	Fresh

Site Structure and Composition



Advance Growth	Forest Stage					
	Immature		Mature		Overmature	
	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)
Sb	0	N/A	702	N/A	3312	N/A
Bf	3513	N/A	905	N/A	975	N/A

Seedbed	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen
	0	45	50	5	0	0	45	50	5	0	0	45	55	0	0

Coarse Woody Debris	Logs	Debris	Logs	Debris	Logs	Debris
	N/A	N/A	N/A	N/A	N/A	N/A

Vegetation and Soil Type Relationships
(number of plots with defined combinations)

5 Aspen Hardwood	6 Trembling Aspen (White Birch) – Balsam Fir / Mountain Maple	7 Trembling Aspen – Balsam Fir / Balsam Fir Shrub	8 Trembling Aspen (White Birch) / Mountain Maple	9 Trembling Aspen Mixedwood	10 Trembling Aspen – Black Spruce – Jack Pine / Low Shrub	11 Trembling Aspen – Conifer / Blueberry / Feathermoss	14 Balsam Fir Mixedwood		
▒	▒	□	▒	▒	▒	□	■		
6	9	5	4	2	4		6	▒	S4 – Fresh / Silty – Silt Loamy
1	1		1	1	2	1	1	□	SS7– Shallow – Moderately Deep / Silty – Fine Loamy – Clayey

Description of Soil and Vegetation

▒	Characteristic Common
■	Common Inclusions
□	Characteristic Uncommon

Selected Species Habitat Use

Species	Forest Stage					Special Habitat Preferences
	Pre-sapling	Sapling	Immature	Mature	Overmature	
Spruce Grouse						
Great Grey Owl						
Black-backed Woodpecker				○	○	snags
Pileated Woodpecker				●	●	snags, downed woody debris
Least Flycatcher				○	○	often found near open spaces (edge, riparian)
Boreal Chickadee				○	○	snags
Swainson's Thrush			●	●	●	
Nashville Warbler		○	○	○		high level of light penetration, preferably with shallow undergrowth
Connecticut Warbler						nests in spruce bogs/tamarack fens with well developed understorey
White-throated Sparrow	○	○			○	numerous openings with low dense vegetation
Northern Flying Squirrel				○	○	snags
Southern Red-backed Vole		○	○	○	○	downed woody debris
Meadow Vole	●					fields, grassy meadows
Marten			○	●	●	snags, downed woody debris
Woodland Caribou (winter)						
Woodland Caribou (hab. rank)						
White-tailed Deer (forage)	●	●			●	
White-tailed Deer (cover)			○	○	○	
Moose (forage)	●	●	○	○	○	
Moose (cover)			○	○	○	

○ Used Habitat ● Preferred Habitat

Successional Relationships - Natural

These stands are often dominated by trembling aspen and white birch in the canopy. Pure upper canopies of hardwood are possible, but white spruce, balsam fir, black spruce and/or the other hardwood are occasional codominants. Total tree cover remains high during much of this stands existence. The tall and low shrub layers are usually dominated by balsam fir although white birch and black spruce can also occur. Stand age varies from 40 to 167 years with the majority of sites occurring in the 40 to 100 year range.

The tall and low shrub layers beneath an aspen dominated stand are often dominated by *Acer spicatum*, *Alnus viridis* and *Corylus cornuta*; *Diervilla lonicera* is present in the low shrub layer at high cover. *Alnus viridis* is the most frequently occurring tall shrub and possesses high cover on this ecosite. Tall shrubs are frequent and occur at moderate cover in most stands. The herb layer is floristically rich and herb cover is high. *Aster macrophyllus, Rubus pubsecens* and *Aralia nudicaulis* are the most abundant herbs. Other moisture-loving species such as *Mitella nuda, Coptis trifolia* and *Athyrium filix-femina* also are common on ES23 with high cover. Mosses remain a minor component in the understorey.

In the absence of the spruce budworm, the overall successional trajectory for these stands is toward a more open, multi-tiered and uneven-aged canopy of mixed species composition. By age 35 years, the spruce component of the mixedwood steadily increases to approximately 1800 stems per hectare, provided that a spruce seed source is available. By age 85 years, spruce will constitute up to 15 percent of the dominant/co-dominant stems. Hardwood canopy cover increases up to age 60 years on this ecosite years and then begins to decline as the intolerant hardwoods begin to ‘fall out’ of the canopy due to pathological problems. The hardwood component is slowly replaced by coniferous species, particularly, white spruce and balsam fir. The oldest stands are uneven-aged and show strong conifer regeneration in the sub-canopy and seedling layers. Residual aspen stems from the original stand may persist for 200 years or more on moist sites. White birch persists in the sub-canopy of some stands - the result of light, surface fires beneath the main canopy. At extended rotations, white spruce will form a super-canopy with a main canopy of balsam fir, white birch and black spruce.

Black spruce may be favored by gap creation created through stand breakup of the white birch dominated mixedwoods. Likewise, balsam fir is favored by gap creation in trembling aspen dominated mixedwoods. At even older ages (140 years) and in the absence of fire, sparse regeneration of the hardwood components results in an increasing dominance by woody shrubs such as *Acer spicatum* and shade tolerant conifers such as balsam fir. The balsam fir sub-canopy component in aspen dominated stands eventually grows through into the main canopy; in contrast, it is black spruce which dominates in the older birch mixedwoods. Species richness, diversity and evenness increase marginally over time. Mean tree species richness, diversity and evenness all increase over time, indicating the increasingly ‘mixed’ nature of the canopy-sub-canopy as stands age.

The cover of tall shrubs and *Diervilla lonicera* generally declines with increasing age whereas *Vaccinium* spp. increases in abundance and distribution. Suckering by trembling aspen is common, but these individuals seldom enter the sub-canopy. Herb cover declines after 100 years reflecting the increase in canopy cover by conifers and the associated change in light conditions and the geochemistry of the forest floor.

Successional Relationships - Post-harvest

Response following harvest:

Post-harvest successional patterns are extremely complex and difficult to predict due to the combined interaction of soil/site conditions, original stand conditions, season of harvest and severity and duration of the harvest activity. Following harvest, aspen and white birch increase in density and dominance due to rapid sprouting and suckering. Removal of the overstorey results in the reproduction and growth of wood shrubs and the herbaceous layer. This site is slightly more moist and rich than ES19 and the vigour of woody shrub re-growth is enhanced. For example, raspberry commonly occurs in the post-harvest condition. In addition herbaceous species and graminoids will rapidly invade this site following mineral soil exposure or mixing. Grasses are generally aided by summer logging.

The protection of conifer advance growth often will result in stand development patterns and compositions similar to that following wildfire; however, the prevalent species in the post-logging cover type is balsam fir due to lack of a spruce seed source and a sufficient quantity and quality of receptive seedbed for white and black spruce. This ecosite has a low probability of sufficient number and distribution of black spruce advance growth to form a significant component of the new stand. Careful logging techniques will result in a mixed wood stand condition where balsam fir is a significant component.

Response following harvest and mechanical site preparation:

Following harvest, aspen and white birch increase in density and dominance due to rapid sprouting and suckering. Removal of the overstorey results in the reproduction and growth of wood shrubs and the herbaceous layer. Mechanical site preparation stimulates hardwood suckering and sprouting of shrubs - especially *Corylus cornuta* by stimulating reproduction from underground sprouts. Disc trenching, blading and use of a brush blade will reduce the cover and abundance of the *Corylus cornuta* but will have minimal effect on *Acer spicatum*. The cover by herbs also increases especially medium and wide-bladed grasses such as *Calamagrostis canadensis* and *Aster macrophylllus*. However, mechanical site preparation on these sites is very effective in reducing the proportion of balsam fir in the new stand arising from advance growth present at time of harvest. Post-harvest advance regeneration of balsam fir which survives following mechanical site preparation is generally of poor quality. Overall, mechanical site preparation will create a successional shift to favor hardwoods.

Response following harvest and prescribed fire:

High intensity severe prescribed burns will effectively reduce the density and dominance of aspen and white birch in the regeneration phase as well as *Acer spicatum* and *Corylus cornuta*. Low intensity prescribed fire will stimulate the regeneration of the *Corylus cornuta* but repeat summer fires will exhaust stored food reserves and reduce its ability to re-sprout. Prescribed fire on this site generally creates exceptional seedbed conditions for a variety of grass species which colonize via rhizomes and wind-borne seeds. Prescribed fire of existing grass will stimulate seeding. Prescribed fire is successful in eliminating balsam fir regeneration and advance growth; the degree of impact is related to severity and intensity of the burn.

Site Productivity

Site Index by species and NWO FEC Soil Type

Site Index (breast height age 50 years)

Soil Type	Species		
	Sb	Pj	Po
S4	13.8	21.2	21.4
SS7	13.7	14.2	22.2

Black Spruce Advance Regeneration

	Vegetation Type			
	V5	V6	V7	V8
Stocking (%)	N/A	N/A	N/A	3
Stocking Range	N/A	N/A	N/A	0 – 6
Stems per ha	N/A	N/A	N/A	100

V5, V6, V7 and V8 are the characteristic vegetation types.

Trembling aspen, white birch and balsam fir dominate the ecosite.

This ecosite has a low probability of sufficient number and distribution of black spruce advance growth to regenerate the site.

The number and distribution of black spruce advance growth on this ecosite is positively related to:

- basal area of black spruce in the original stand

and inversely related to:

- percent cover of broadleaf litter
- percent canopy closure
- percent cover of herbaceous species

Natural Ingress Probability and Density (ten years post-disturbance)

Information not available

Critical Comments

- Occasional large quantities of decadent trembling aspen may occur dependant upon aspen clonal properties and soil moisture regime.
- Heavy woody shrub and hardwood tree competition from mountain maple, green and speckled alder, beaked hazel and balsam fir should be expected. *Calamagrostis canadensis* and seedling balsam fir is often abundant following harvest when excessive amounts of soil are disturbed.
- Stands are vulnerable to spruce budworm if the proportion of balsam fir and white spruce in the stands exceeds 20 percent of the total crown volume.
- Natural regeneration of black spruce and jack pine limited by available local seed supply and lack of suitable supply and duration of receptive seedbed and smothering from hardwood leaf litter.
- Natural regeneration heavily dominated by balsam fir.
- Extensive slash resulting from, dead and dying balsam fir, residual balsam fir and balsam fir advance growth will limit the effectiveness of intermittent patch scarifiers and passive disc-trenchers.

Site Characteristics, Limitations and Hazard Potential

Characteristics							Limitations				Hazard Potential				
LFH Layer	Soil Texture	Depth to Bedrock	Stoniness	Moisture Regime	Terrain	Competition	Windthrow	Frost Heaving	Drought/Desiccation	Seasonal Flooding	Compaction	Rutting	Soil Erosion	Biomass & Nutrient Removal	Silvicultural Activities
1	1,3			4	3						4	4	1,3		Harvesting
1,2	1,3			4	3	1,5		1			4	4	1,3		Renewal
	1,3					1,5									Tending

Footnotes:

1. Disturbance of the forest floor on fine textured soils will promote non-crop vegetation and increase potential for erosion and frost heaving.
2. LFH layer is a poor seedbed.
3. Soil erosion hazard increases with silt content. Hazard is moderate to high on slopes greater than ten percent.
4. Fine textured soils are susceptible to compaction and rutting when saturated during the frost free period.
5. Very high competition. Mountain maple, beaked hazel, white birch, aspen, balsam fir and blue-joint grass are the principle competitors.

Opportunities

- This ecosite can also be managed to support forests dominated by balsam fir, white spruce, and/or white birch.
- Site quality for aspen growth and wood quality enhanced on this site, expecially where stone content approaches 30 percent and soils are calacareous.
- White spruce and black spruce seed trees, combined with site preparation for mineral soil exposure, can augment conifer regeneration levels.
- Use prescribed fire after harvest to eliminate dense balsam fir advance growth and create plantable spots or stimulate aspen suckering.
- Browse production potential is high, both before and after harvest.
- This ecosite may provide winter shelter for moose depending upon the habitat mosaic.
- Stands associated with this ecosite have a high degree of structural diversity contributing to their importance as potential habitat for small mammals, furbearers and a large number of songbirds.
- Soil active herbicides generally available for use on fine textured soils.

Silvicultural Intensity Considerations

Species Objective	Site Productivity	Degree of Effort to Reach Free-to-grow
Black spruce	1	3
Jack pine	1	3
Aspen	1	1

Degree of Effort

1 = Extensive
2 = Basic
3 = Intensive
4 = Highly Intensive

Site Productivity - Site Productivity class (prime land productivity class) based upon height of dominant trees at age 50 years (breast height).

Silvicultural Interpretations for the Establishment of Black Spruce

Silvicultural System **• Harvest Method**		**Comments**
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	R	Residual stand will not contribute seed of sufficient quantity. However, this cutting technique may be prescribed to meet other management objectives.
- Patch	R	See Strip/Block comment.
- Seed-tree	NR	Potential for natural seeding is very low due to infrequent occurrence of black spruce in the original stand, lack of receptive seedbed and potential for competition.
Shelterwood	NR	Black spruce is mid-tolerant and susceptible to windthrow after thinning of closed canopy stands.
Selection	NR	See Shelterwood comment.
Logging Method		Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season.
Full-tree	R	
Tree-length	R	Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	R	See Tree-length comment.
Renewal Treatments		
Site Preparation		Very high competition on this site.
• Mechanical	R	Techniques, timing and sequencing of treatments should be carefully considered. Minimize mineral soil exposure on clays to reduce the incidence of soil baking and/or frost heaving, and to prevent increased competition from non-crop vegetation on a mixed mineral/organic microsite. Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season. Chemi-mechanical site preparation should be considered. Potential for standing dead and down woody debris resulting from repeat spruce budworm infestation is high and will affect equipment operability and effectiveness.
• Chemical	R	Some herbicide-resistant non-crop species may occur on this site.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Black Spruce (con't)

Renewal Treatments	**Comments**	
• Prescribed Burn	R	Severity of burn will affect vegetation response. Fire will be beneficial for reduction of balsam fir competition, standing dead and down woody debris and associated heavy slash loads.
Regeneration • Natural - Advance Growth	NR	Black spruce advance growth is not of sufficient quantity or distribution to fully regenerate the site.
- Seed	NR	Potential for natural seeding is very low due to infrequent occurrence of black spruce in the original stand.
- Vegetative (coppice)	NR	Black spruce does not coppice.
• Artificial - Planting	R	Plant close to the mineral/organic interface.
- Seeding	NR	Smothering of seedbeds with hardwood litter will limit success. In addition, the distribution, abundance and vigour of non-crop species precludes the survival and growth of seed origin black spruce.
- Scarification	NR	Cone loading is low due to low density of black spruce in the original stand.
Tending Treatments		
Cleaning		Very high competition on this site.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing is usually not necessary since black spruce natural regeneration is minimal.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine

Silvicultural System • Harvest Method		Comments
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	R	Residual stand will not contribute seed of sufficient quantity or genetic quality. However, this cutting technique may be prescribed to meet other management objectives.
- Patch	R	See Strip/Block comment.
- Seed-tree	NR	Potential for natural seeding is very low due to infrequent occurrence of jack pine in the original stand.
Shelterwood	NR	Jack pine is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season.
Full-tree	R	
Tree-length	R	Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	R	See Tree-length comment.
Renewal Treatments		
Site Preparation		Very high competition on this site.
• Mechanical	R	Techniques, timing and sequencing of treatments should be carefully considered. Minimize mineral soil exposure on clays to reduce the incidence of soil baking and/or frost heaving, and to prevent increased competition from non-crop vegetation on a mixed mineral/organic microsite. Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season. Chemi-mechanical site preparation should be considered. Potential for standing dead and down woody debris resulting from repeat spruce budworm infestation is high and will affect equipment operability and effectiveness.
• Chemical	R	Some herbicide-resistant non-crop species may occur on this site.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine (con't)

Renewal Treatments	**Comments**	
• Prescribed Burn	R	Severity of burn will affect vegetation response. Fire will be beneficial for reduction of balsam fir competition, standing dead and down woody debris and associated heavy slash loads
Regeneration • Natural - Advance Growth	NR	Jack pine does not regenerate under a closed canopy.
- Seed	NR	Potential for natural seeding is very low due to infrequent occurrence of jack pine in the original stand.
- Vegetative (coppice)	NR	Jack pine does not coppice.
• Artificial - Planting	R	Plant close to the mineral/organic interface.
- Seeding	NR	Smothering of seedbeds with hardwood litter will limit success. In addition, the distribution, abundance and vigour of non-crop vegetation precludes the survival and growth of seed origin jack pine.
- Scarification	NR	Cone loading is low due to low density of jack pine in the original stand. Cone scattering will give variable results.
Tending Treatments		
Cleaning		Very high competition on this site.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing is usually not necessary since jack pine natural regeneration is minimal.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Trembling Aspen

Silvicultural System **• Harvest Method**	**Comments**	
Clearcut • Harvest Method - Conventional	R	
- Strip	CR	Strips should be at least 20 m wide to warm the soil and stimulate suckering. Strip cutting can also be prescribed to meet other management objectives.
- Patch	CR	Openings 0.4 ha in size are the minimum acceptable to stimulate aspen suckering. Patch cutting can also be prescribed to meet other management objectives.
- Seed-tree	NR	Leaving live aspen will reduce suckering.
Shelterwood	NR	Aspen is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season.
Full-tree	R	
Tree-length	R	Slash remaining on the site will reduce soil temperature and sucker production.
Cut-to-length/Shortwood	R	See Tree-length comment. Concentration of slash in rows by single grip harvesters will create an uneven distribution of aspen suckers.
Renewal Teatments		
Site Preparation • Mechanical	NR	See Scarification (Section II, Book I).
• Chemical	R	Chemical site preparation may be used on sites where the residual overstorey will negatively affect root suckering. 2,4-D is recommended since it will remove the overstorey without damaging the aspen root systems.
• Prescribed Burn	R	

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

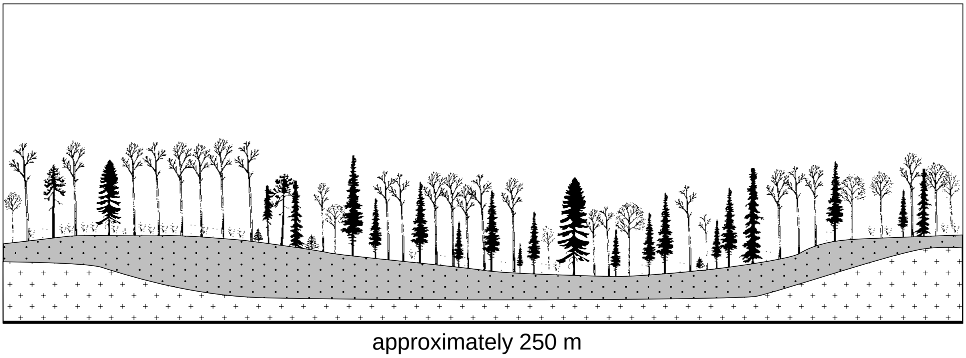
Silvicultural Interpretations for the Establishment of Aspen (con't)

Renewal Treatments	Comments	
Regeneration • Natural - Advance Growth	NR	Aspen does not regenerate under a closed canopy.
- Seed	NR	Aspen regeneration from seed is highly variable.
- Vegetative (coppice)	R	
• Artificial - Planting	NR	Insufficient data and/or field experience exist to recommend this technique. Planting of aspen seedlings may be considered when existing aspen has deteriorated to a point where vegetative regeneration is unlikely or undesirable.
- Seeding	NR	Insufficient data and/or field experience exist to recommend this technique.
- Scarification	R	Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season.
Tending Treatments		
Cleaning		Very high competition on this site.High initial densities and rapid early growth of aspen suckers will ensure their successful renewal.
• Manual	NR	
• Mechanical	NR	
• Chemical - Ground	NR	
- Aerial	NR	
Spacing	R	Site quality and timing is critical for the success of this treatment.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

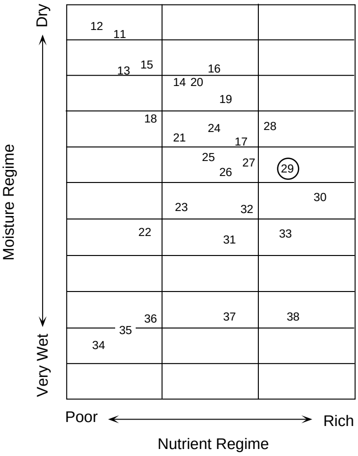
ES 29

Hardwood–Fir–Spruce Mixedwood: Fresh, Fine Loamy–Clayey Soil



General Description

Dominated by trembling aspen and occasionally white birch, with a conifer mix of balsam fir, white spruce, black spruce and occasionally jack pine. Deciduous trees comprise more than 50% of the canopy. Shrub- and herb-rich. Soils fresh, moderately well to well drained, fine loamy–clayey. Developed primarily on lacustrine parent material. Ground cover consists of broadleaf litter, conifer litter, feathermoss and wood.



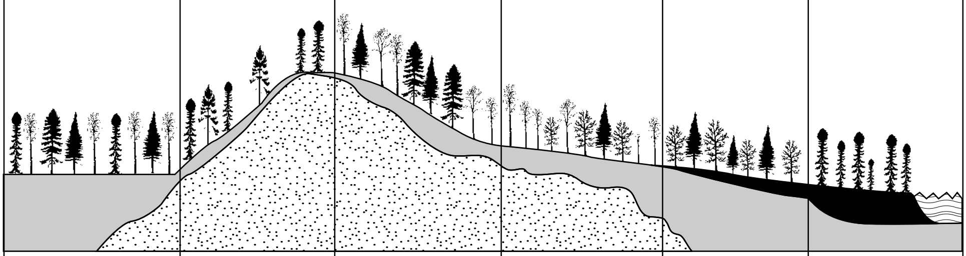
Soil Types
S5, S6, SS7
Mode of Deposition
lacustrine
Humus Form
fibrimor, humifibrimor
Overstorey
trembling aspen, balsam fir, white spruce, black spruce, white birch, jack pine, balsam poplar
Shrubs/Trees (<10 m)
Acer spicatum, Corylus cornuta, Cornus stolonifera, Viburnum edule, Ribes triste, Diervilla lonicera, Lonicera canadensis, Linnaea borealis, balsam fir, *Sorbus decora,* trembling aspen
Herbs and Graminoids
Aster macrophyllus, Fragaria virginiana, Aralia nudicaulis, Streptopus roseus, Viola renifolia, Anemone quinquefolia, Galium triflorum, Clintonia borealis, Trientalis borealis, Maianthemum canadense, Cornus canadensis, Mitella nuda
Mosses and Lichens
Pleurozium schreberi, Ptilium crista-castrensis, Hylocomium splendens

Comments

Plant species composition varies slightly from ES28 as a result of occurring on the finer-textured parent material. Characteristic V-types V4, V5, V6, V7, V8 and V9 occur frequently; V10 and V11 occasionally. Expect to encounter V14 and V16 in local patches and rarely V1, V12 and V13. Yellow birch, red maple, and large-toothed aspen may also occur in Site Regions 4S, 4W and 5S. Apart from the listed S-types, some localities may have small (<10% area) inclusions of SS2 and SS3.

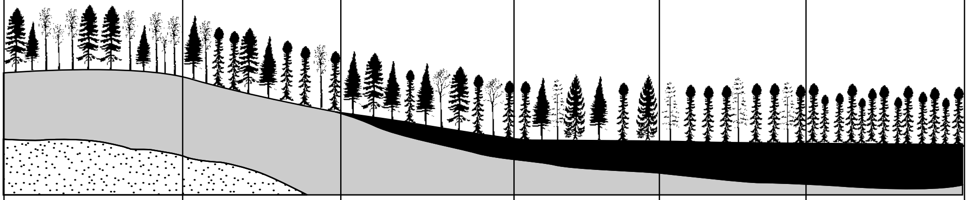
Typical Landscape Associations

Typical Ecosite Sequence on Very Shallow to Deep Silty to Clayey Glaciolacustrine Material



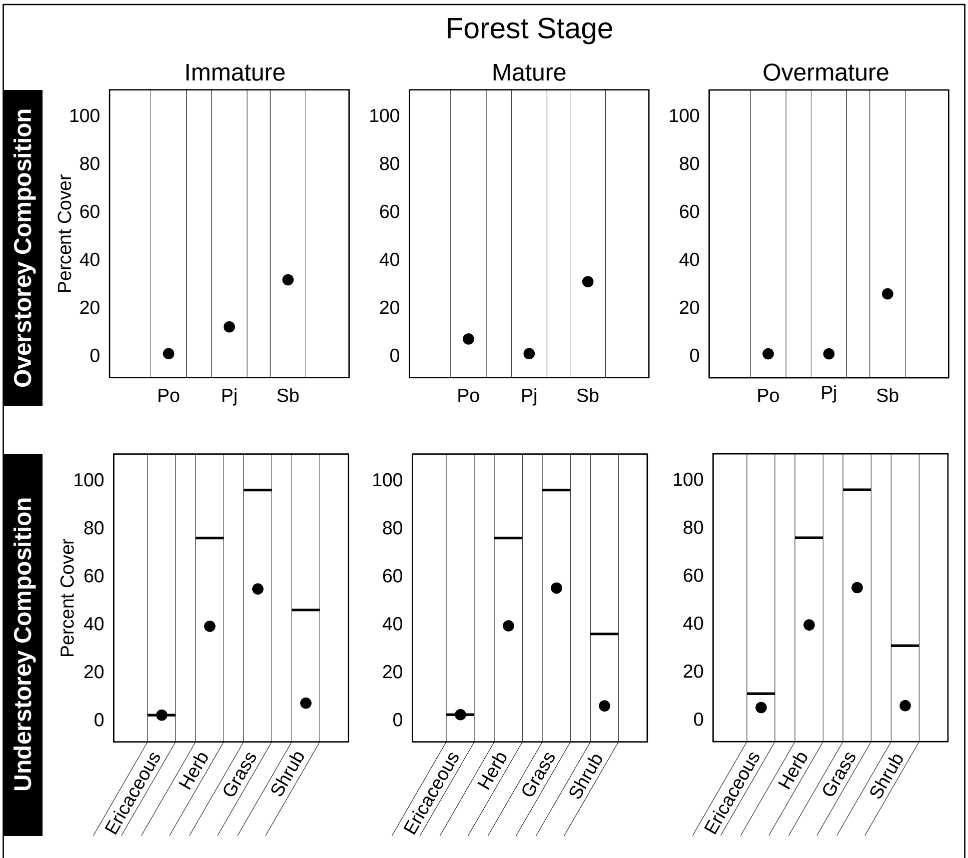
Po-Bf-Sw (Sb)	Sb-Pj	Po-Sw (Bf-Bw)	Ab-Po-Bw (Bf)	Ab (Bf)	Sb
ES33 Hardwood-Fir-Spruce Mixedwood: Moist, Silty-Clayey Soil	ES12 Black Spruce-Jack Pine: Very Shallow Soil	ES29 Hardwood-Fir-Spruce Mixedwood: Fresh, Fine Loamy-Clayey Soil	ES30 Black Ash Hardwood: Fresh, Silty-Clayey Soil	ES38 Rich Swamp: Black Ash (Other Hardwood): Organic-Mineral Soil	ES36 Intermediate Swamp: Black Spruce, (Tamarack): Organic Soil
V7 Trembling Aspen-Balsam Fir/ Balsam Fir Shrub	V30 Jack Pine-Black Spruce/ Blueberry/Lichen	V9 Trembling Aspen Mixedwood	V2 Black Ash Hardwood and Mixedwood	V2 Black Ash Hardwood and Mixedwood	V35 Black Spruce/ Speckled Alder/ Sphagnum
S10 Moist/Fine Loamy-Clayey	SS2 Extremely Shallow Soil on Bedrock	SS7 Shallow-Moderately Deep/ Silty-Fine Loamy-Clayey	S10 Moist/Fine Loamy-Clayey	S12F Wet/Organic (Feathermoss)	S12S Wet/Organic (Sphagnum)
Moist	Dry	Fresh	Moist	Wet	Wet

Typical Ecosite Sequence on Deep Silty to Clayey Glaciolacustrine Material



Po-Sw (Bf)	Sb-Bf-Sw (Po)	Bf-Sw (Pb-Sb)	Ce-Bf (Sb-Ta)	Sb-Ta	Sb
ES29 Hardwood-Fir-Spruce Mixedwood: Fresh, Loamy-Clayey Soil	ES27 Fir-Spruce Mixedwood: Fresh, Silty-Fine Loamy Soil	ES32 Fir-Spruce Mixedwod: Moist, Silty-Clayey Soil	ES37 Rich Swamp: Cedar (Other Conifer): Organic Soil	ES36 Intermediate Swamp: Black Spruce (Tamarack): Organic Soil	ES35 Poor Swamp: Black Spruce: Organic Soil
V8 Trembling Aspen (White Birch)/ Mountain Maple	V16 Balsam Fir-White Spruce Mixedwood/ Feathermoss	V14 Balsam Fir Mixedwood	V22 Cedar (inc. Mixedwood)/ Speckled Alder/ Sphagnum	V23 Tamarack (Black Spruce)/ Speckled Alder/ Labrador-tea	V37 Black Spruce/ Ericaceous Shrub/ Sphagnum
S5 Fresh/ Fine Loamy	S6 Fresh/Clayey	S10 Moist/Fine Loamy-Clayey	S12F Wet/Organic (Feathermoss)	S12S Wet/Organic (Sphagnum)	S12S Wet/Organic (Sphagnum)
Fresh	Fresh	Moist	Wet	Wet	Wet

Site Structure and Composition



Advance Growth	Forest Stage					
	Immature		Mature		Overmature	
	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)
Sb	1211	N/A	1500	N/A	1188	N/A
Bf	1799	N/A	3528	N/A	1188	N/A

Seedbed															
	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen
	15	2	82	0	1	15	2	82	0	1	15	2	82	0	1

Coarse Woody Debris						
	Logs	Debris	Logs	Debris	Logs	Debris
	N/A	N/A	N/A	N/A	N/A	N/A

Vegetation and Soil Type Relationships

(number of plots with defined combinations)

5 Aspen Hardwood	6 Trembling Aspen (White Birch) – Balsam Fir / Mountain Maple	7 Trembling Aspen – Balsam Fir / Balsam Fir Shrub	8 Trembling Aspen (White Birch) / Mountain Maple	9 Trembling Aspen Mixedwood	10 Trembling Aspen – Black Spruce – Jack Pine / Low Shrub	11 Trembling Aspen – Conifer / Blueberry / Feathermoss	14 Balsam Fir Mixedwood			
▨	▨	▨	▨	▨	□	□	■			
3	2		2	4	2		1	▨	S5 –	Fresh / Fine Loamy
8	3	12	4	13	3	1	8	▨	S6 –	Fresh / Clayey
1	1		1	1		1	1	□	SS7–	Shallow – Moderately Deep / Silty – Fine Loamy – Clayey

Description of Soil and Vegetation

▨ Characteristic Common

■ Common Inclusions

□ Characteristic Uncommon

Selected Species Habitat Use

Species	Forest Stage					Special Habitat Preferences
	Pre-sapling	Sapling	Immature	Mature	Overmature	
Spruce Grouse						
Great Grey Owl						
Black-backed Woodpecker				○	○	snags
Pileated Woodpecker				●	●	snags, downed woody debris
Least Flycatcher				○	○	often found near open spaces (edge, riparian)
Boreal Chickadee				○	○	snags
Swainson's Thrush			●	●	●	
Nashville Warbler		○	○	○		high level of light penetration, preferably with shallow undergrowth
Connecticut Warbler						
White-throated Sparrow	○	○			○	numerous openings with low dense vegetation
Northern Flying Squirrel				○	○	snags
Southern Red-backed Vole		○	○	○	○	downed woody debris
Meadow Vole	●					fields, grassy meadows
Marten			○	●	●	snags, downed woody debris
Woodland Caribou (winter)						
Woodland Caribou (hab. rank)						
White-tailed Deer (forage)	●	●			●	
White-tailed Deer (cover)			○	○	○	
Moose (forage)	●	●	○	○	○	
Moose (cover)			○	○	○	

○ Used Habitat ● Preferred Habitat

Successional Relationships - Natural

See ES28.

Successional Relationships - Post-harvest

Response following harvest:

See ES28.

Response following harvest and mechanical site preparation:

See ES28.

Response following harvest and prescribed fire:

See ES28.

Site Productivity

Site Index by species and NWO FEC Soil Type

Site Index (breast height age 50 years)

Soil Type	Species		
	Sb	Pj	Po
S5	16.8	N/A	20.3
S6	12.8	17.3	19.3
SS7	13.7	14.2	22.2

Black Spruce Advance Regeneration

	Vegetation Type					
	V5	V6	V7	V8	V9	V14
Stocking (%)	N/A	N/A	N/A	3	10	N/A
Stocking Range	N/A	N/A	N/A	0 – 6	0 – 25	N/A
Stems per ha	N/A	N/A	N/A	100	900	N/A

V5, V6, V7 and V8 are the characteristic vegetation types with V9 and V14 as common inclusions.

Trembling aspen, white birch and balsam fir dominate the ecosite.

This ecosite has a low probability of sufficient number and distribution of black spruce advance growth to regenerate the site.

The number and distribution of black spruce advance growth on this ecosite is positively related to:

- basal area of black spruce in the original stand

and inversely related to:

- percent cover of broadleaf litter
- percent canopy closure
- percent cover of herbaceous species

Natural Ingress Probability and Density (ten years post-disturbance)

Seedbed Condition	Species and Height Class					
	Sb		Pj		Po	
	< 1.0	> 1.0	< 1.0	>1.0	< 1.0	>1.0
Duff	X ▒	X ▒	X ░	X ░	M ░	X ▉
Mineral Soil	Insufficient Data					
Burned	Insufficient Data					

Probability Class

V- < 21%
L- 21 - 40%
M- 41 - 60%
H- 61 - 80%
X- > 80%

Density Class

░ < 300
▒ 300 - 1000
▓ 1001 - 5000
▉ 5001 - 10000
█ > 10000

- Aspen natural regeneration dominates this ecosite. Jack pine is virtually absent. Black spruce is the dominant species in the understorey, but only at a low density.
- Compared to that of aspen, black spruce ingress is not prolonged. Within six years after disturbance, black spruce ingress is complete, and half of it establishes within two years after disturbance. This is probably because suitable seedbed vanishes quickly due to shrub and herb competition on this rich site.

Critical Comments

- Occasional large quantities of decadent trembling aspen may occur dependant upon aspen clonal properties and soil moisture regime.
- Heavy woody shrub and hardwood tree competition from mountain maple, green and speckled alder, beaked hazel and balsam fir should be expected. *Calamagrostis canadensis* and seedling balsam fir is often abundant following harvest when excessive amounts of soil are disturbed.
- Stands are vulnerable to spruce budworm if the proportion of balsam fir and white spruce in the stands exceeds 20 percent of the total crown volume.
- Soil/site conditions limit the use of hexazinone products for chemical site preparation.
- Natural regeneration of black spruce and jack pine limited by available local seed supply and lack of suitable supply and duration of receptive seedbed and smothering from hardwood leaf litter.
- Natural regeneration heavily dominated by balsam fir.
- Extensive slash resulting from, dead and dying balsam fir, residual balsam fir and balsam fir advance growth will limit the effectiveness of intermittent patch scarifiers and passive disc-trenchers.

Site Characteristics, Limitations and Hazard Potential

Characteristics							Limitations				Hazard Potential			
LFH Layer	Soil Texture	Depth to Bedrock	Stoniness	Moisture Regime	Terrain	Competition	Windthrow	Frost Heaving	Drought/Desiccation	Seasonal Flooding	Compaction	Rutting	Soil Erosion	Biomass & Nutrient Removal	Silvicultural Activities
1	1,2			3	2						3	3	1,2		Harvesting
1	1,2			3	2	1,4		1			3	3	1,2		Renewal
	1,2					1,4									Tending

Footnotes:

1. Disturbance of the forest floor on fine textured soils will promote non-crop vegetation and increase the potential for erosion and frost heaving.
2. Soil erosion hazard increases with silt content. Hazard is moderate to high on slopes greater than ten percent.
3. Fine textured soils are susceptible to compaction and rutting when saturated during the frost free period.
4. Very high competition. Mountain maple, beaked hazel, aspen, balsam fir and blue-joint grass are the principle competitors.

Opportunities

- This ecosite can also be managed to support forests dominated by balsam fir, white spruce, and/or white birch.
- Site quality for aspen growth and wood quality enhanced on this site, expecially where stone content approaches 30 percent and soils are calcarcous.
- White spruce and black spruce seed trees, combined with site preparation for mineral soil exposure, can augment conifer regeneration levels.
- Use prescribed fire after harvest to eliminate dense balsam fir advance growth and create plantable spots or stimulate aspen suckering.
- Browse production potential is high, both before and after harvest.
- This ecosite may provide winter shelter for moose depending upon the habitat mosaic.
- Stands associated with this ecosite have a high degree of structural diversity contributing to their importance as potential habitat for small mammals, furbearers and a large number of songbirds.

Silvicultural Intensity Considerations

Species Objective	Site Productivity	Degree of Effort to Reach Free-to-grow
Black spruce	1	3
Jack pine	1	3
Aspen	1	1

Site Productivity - Site Productivity class (prime land productivity class) based upon height of dominant trees at age 50 years (breast height).

Degree of Effort

1 = Extensive
2 = Basic
3 = Intensive
4 = Highly Intensive

Silvicultural Interpretations for the Establishment of Black Spruce

Silvicultural System **• Harvest Method**		**Comments**
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	R	Residual stand will not contribute seed of sufficient quantity. However, this cutting technique may be prescribed to meet other management objectives.
- Patch	R	See Strip/Block comment.
- Seed-tree	NR	Potential for natural seeding is very low due to infrequent occurrence of black spruce in the original stand, lack of receptive seedbed and potential for competition.
Shelterwood	NR	Black spruce is mid-tolerant and susceptible to windthrow after thinning of closed canopy stands.
Selection	NR	See Shelterwood comment.
Logging Method		Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season.
Full-tree	R	
Tree-length	R	Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	R	See Tree-length comment.
Renewal Treatments		
Site Preparation		Very high competition on this site.
• Mechanical	CR	Techniques, timing and sequencing of treatments should be carefully considered. Minimize mineral soil exposure on clays to reduce the incidence of soil baking and/or frost heaving, and to prevent increased competition from non-crop vegetation on a mixed mineral/organic microsite. Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season. Chemi-mechanical site preparation should be considered. Potential for standing dead and down woody debris resulting from repeat spruce budworm infestation is high and will affect equipment operability and effectiveness.
• Chemical	R	Some herbicide-resistant non-crop species may occur on this site.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Black Spruce (con't)

Renewal Treatments	**Comments**	
• Prescribed Burn	R	Severity of burn will affect vegetation response. Fire will be beneficial for reduction of balsam fir competition, standing dead and down woody debris and associated heavy slash loads.
Regeneration • Natural - Advance Growth	NR	Black spruce advance growth is not of sufficient quantity or distribution to regenerate the site.
- Seed	NR	Low levels of black spruce ingress due to infrequent occurrence of black spruce in the original stand.
- Vegetative (coppice)	NR	Black spruce does not coppice.
• Artificial - Planting	R	Plant close to the mineral/organic interface.
- Seeding	NR	Reduced seeding success on clay soils. Smothering of seedbeds with hardwood litter will further limit success. In addition, the distribution, abundance and vigour of competitive non-crop vegetation precludes the survival and growth of seed origin black spruce.
- Scarification	NR	Cone loading is low due to low density of black spruce in the original stand. Competition from non-crop species will be a problem on scarified soil.
Tending Treatments		
Cleaning		Very high competition on this site.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing is usually not necessary since black spruce natural regeneration is minimal.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine

Silvicultural System **• Harvest Method**		**Comments**
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	R	Residual stand will not contribute seed of sufficient quantity or genetic quality. However, this cutting technique may be prescribed to meet other management objectives.
- Patch	R	See Strip/Block comment.
- Seed-tree	NR	Potential for natural seeding is very low due to infrequent occurrence of jack pine in the original stand.
Shelterwood	NR	Jack pine is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season.
Full-tree	R	
Tree-length	R	Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	R	See Tree-length comment.
Renewal Treatments		
Site Preparation		Very high competition on this site.
• Mechanical	CR	Techniques, timing and sequencing of treatments should be carefully considered. Minimize mineral soil exposure on clays to reduce the incidence of soil baking and/or frost heaving, and to prevent increased competition from non-crop vegetation on a mixed mineral/organic microsite. Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season. Chemi-mechanical site preparation should be considered. Potential for standing dead and down woody debris resulting from repeat spruce budworm infestation is high and will affect equipment operability and effectiveness.
• Chemical	R	Some herbicide-resistant non-crop species may occur on this site.
• Prescribed Burn	R	Severity of burn will affect vegetation response. Fire will be beneficial for reduction of balsam fir competition, standing dead and down woody debris and associated heavy slash loads.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine (con't)

Renewal Treatments	Comments	
Regeneration • Natural - Advance Growth	NR	Jack pine does not regenerate under a closed canopy.
- Seed	NR	Very low levels of jack pine ingress. Infrequent occurrence of jack pine in the original stand precludes natural regeneration by seed.
- Vegetative (coppice)	NR	Jack pine does not coppice.
• Artificial - Planting	R	Plant close to the mineral/organic interface.
- Seeding	NR	Smothering of seedbeds with hardwood litter will limit success. In addition, the distribution, abundance and vigour of competitive non-crop species precludes survival and growth of seed origin jack pine.
- Scarification	NR	Cone loading is low due to low density of jack pine in the original stand. Cone scattering will give variable results.
Tending Treatments		
Cleaning		Very high competition on this site.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing is usually not necessary since jack pine natural regeneration is minimal.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Aspen

Silvicultural System **• Harvest Method**	**Comments**	
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	CR	Strips should be at least 20 m wide to warm the soil and stimulate suckering. Strip cutting can also be prescribed to meet other management objectives.
- Patch	CR	Openings 0.4 ha in size are the minimum acceptable to stimulate aspen suckering. Patch cutting can also be prescribed to meet other management objectives.
- Seed-tree	NR	Leaving live aspen will reduce suckering.
Shelterwood	NR	Aspen is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season.
Full-tree	R	
Tree-length	R	Slash remaining on the site will reduce soil temperature and sucker production.
Cut-to-length/Shortwood	R	See Tree-length comment. Concentration of slash in rows by single grip harvesters will create an uneven distribution of aspen suckers.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

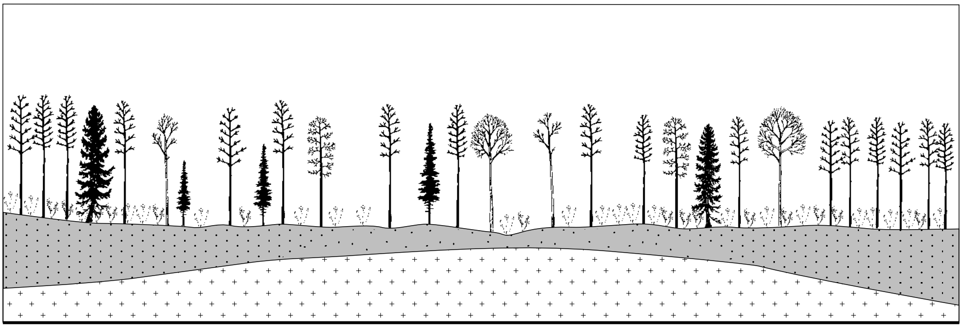
Silvicultural Interpretations for the Establishment of Aspen (con't)

Renewal Treatments		**Comments**
Site Preparation • Mechanical	NR	See Scarification (Section II, Book I).
• Chemical	R	Chemical site preparation may be used on sites where the residual overstorey will negatively affect root suckering. 2,4-D is recommended since it will remove the overstorey without damaging the aspen root systems.
• Prescribed Burn	R	
Regeneration • Natural - Advance Growth	NR	Aspen does not regenerate under a closed canopy.
- Seed	NR	Aspen regeneration from seed is highly variable.
- Vegetative (coppice)	R	
• Artificial - Planting	NR	Insufficient data and/or field experience exist to recommend this technique. Planting of aspen seedlings may be considered when existing aspen has deteriorated to a point where vegetative regeneration is unlikely or undesirable.
- Seeding	NR	Insufficient data and/or field experience exist to recommend this technique.
- Scarification	R	Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season.
Tending Treatments		
Cleaning		Very high competition on this site. High initial densities and rapid early growth of aspen suckers will ensure their successful renewal.
• Manual	NR	
• Mechanical	NR	
• Chemical - Ground	NR	
- Aerial	NR	
Spacing	R	Site quality and timing is critical for the success of this treatment.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Black Ash Hardwood: Fresh, Silty–Clayey Soil

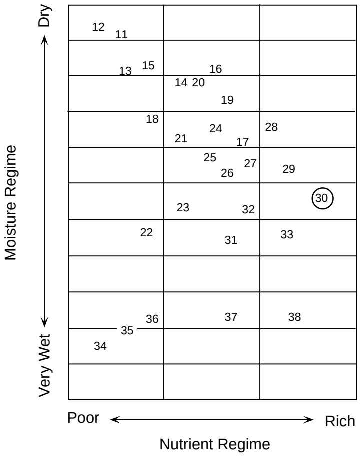
ES 30



approximately 250 m

General Description

Dominated by black ash with occurrences of trembling aspen, white birch, balsam poplar and white cedar. Shrub- and herb-rich. Soils fresh to moist, well to imperfectly drained, silty to clayey textured. Predominantly on lacustrine parent materials. Ground cover consists of broadleaf litter, graminoid litter, feathermoss and wood.



Soil Types
S5, S6, S10, S4

Mode of Deposition
lacustrine

Humus Form
humifibrimor, fibrimor, mull

Overstorey
black ash, trembling aspen, white birch, balsam poplar, white cedar

Shrubs/Trees (<10 m)
balsam fir, *Rubus pubescens, Amelanchier spp., Prunus virginiana, Rubus idaeus, Lonicera canadensis, Ribes triste, Acer spicatum, Corylus cornuta, Ribes hirtellum*

Herbs and Graminoids
Aralia nudicaulis, Equisetum sylvaticum, Maianthemum canadense, Aster macrophyllus, Fragaria virginiana, Streptopus roseus, Cinna latifolia, Dryopteris carthusiana, Athyrium filix-femina, Circaea alpina, Galium triflorum, Mitella nuda

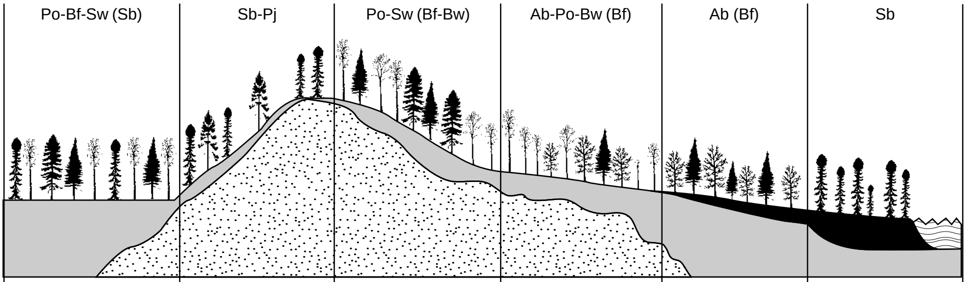
Mosses and Lichens
Drepanocladus spp., Climacium dendroides, Thuidium spp.

Comments

Ecosite is characteristically found in subdued topography and depressions. Often associated with fine-textured soils and small intermittent watercourses. Transitions to SS9 and S11 peaty-phase soils are common. Characteristic V-type is V2, but V1 and V22 also occur. A wide variety of other vegetative conditions may occur, occasionally including red maple in Site Regions 4S, 4W and 5S. Grades to ES38 on alluvial plains and low-lying areas adjacent to lakes.

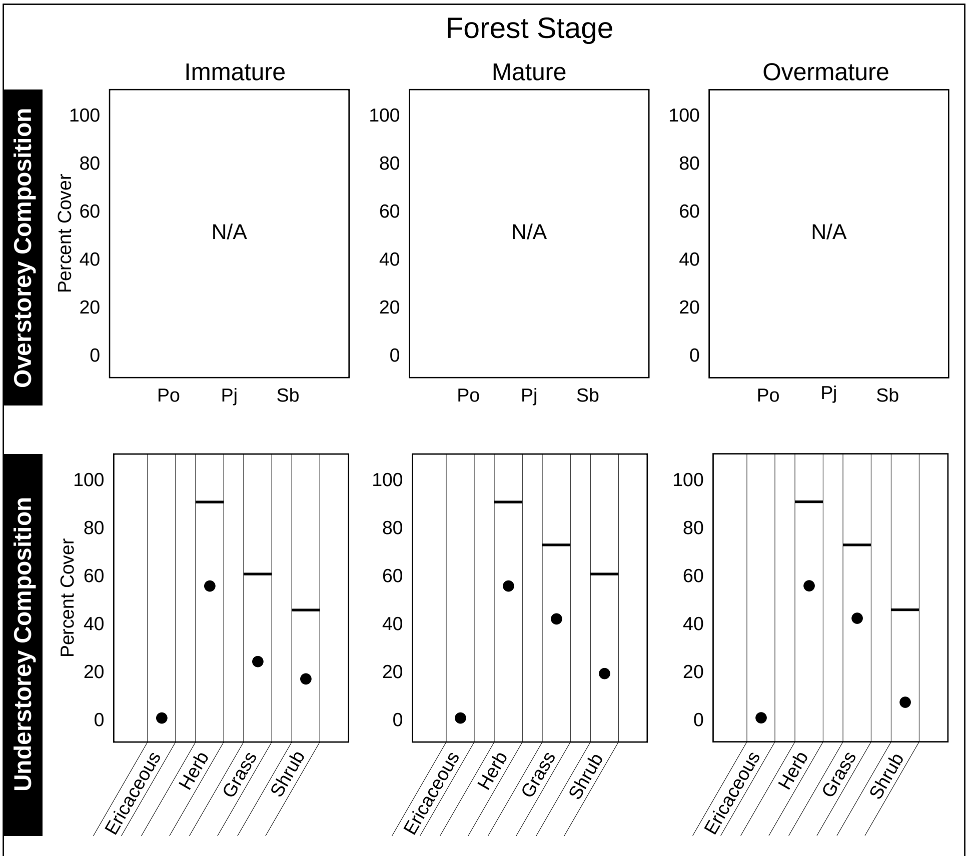
Typical Landscape Associations

Typical Ecosite Sequence on Very Shallow to Deep Silty to Clayey Glaciolacustrine Material



ES33 Hardwood-Fir-Spruce Mixedwood: Moist, Silty-Clayey Soil	ES12 Black Spruce-Jack Pine: Very Shallow Soil	ES29 Hardwood-Fir-Spruce Mixedwood: Fresh, Fine Loamy-Clayey Soil	ES30 Black Ash Hardwood: Fresh, Silty-Clayey Soil	ES38 Rich Swamp: Black Ash (Other Hardwood): Organic-Mineral Soil	ES36 Intermediate Swamp: Black Spruce, (Tamarack): Organic Soil
V7 Trembling Aspen-Balsam Fir/ Balsam Fir Shrub	V30 Jack Pine-Black Spruce/ Blueberry/Lichen	V9 Trembling Aspen Mixedwood	V2 Black Ash Hardwood and Mixedwood	V2 Black Ash Hardwood and Mixedwood	V35 Black Spruce/ Speckled Alder/ Sphagnum
S10 Moist/Fine Loamy-Clayey	SS2 Extremely Shallow Soil on Bedrock	SS7 Shallow-Moderately Deep/ Silty-Fine Loamy-Clayey	S10 Moist/Fine Loamy-Clayey	S12F Wet/Organic (Feathermoss)	S12S Wet/Organic (Sphagnum)
Moist	Dry	Fresh	Moist	Wet	Wet

Site Structure and Composition



Advance Growth	Forest Stage					
	Immature		Mature		Overmature	
	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)
Sb	120	N/A	96	N/A	N/A	N/A
Bf	640	N/A	930	N/A	580	N/A

Seedbed															
	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen
	0	6	94	0	0	0	6	94	0	0	0	6	94	0	0

Coarse Woody Debris						
	Logs	Debris	Logs	Debris	Logs	Debris
	N/A	N/A	N/A	N/A	N/A	N/A

Vegetation and Soil Type Relationships

(number of plots with defined combinations)

Black Ash Hardwood and Mixedwood	Balsam Poplar Hardwood and Mixedwood	Cedar (inc. Mixedwood) / Speckled Alder / Sphagnum		
2	1	22		
▨	■	□		
	2		▨	S5 – Fresh / Fine Loamy
7	9	1	▨	S6 – Fresh / Clayey
6	10		■	S10 – Moist / Fine Loamy – Clayey
1	3		▨	S4 – Fresh / Silty – Silt Loamy

Description of Soil and Vegetation
- ▨ Characteristic Common
- ■ Common Inclusions
- □ Characteristic Uncommon

Selected Species Habitat Use

Species	Forest Stage					Special Habitat Preferences
	Pre-sapling	Sapling	Immature	Mature	Overmature	
Spruce Grouse						
Great Grey Owl						
Black-backed Woodpecker						
Pileated Woodpecker				○	○	snags, downed woody debris
Least Flycatcher				○	○	often found near open spaces (edge, riparian)
Boreal Chickadee				○	○	snags
Swainson's Thrush			●	●	●	
Nashville Warbler		○	○	○		high level of light penetration, preferably with shallow undergrowth
Connecticut Warbler						
White-throated Sparrow	○	○			○	numerous openings with low dense vegetation
Northern Flying Squirrel				○	○	snags
Southern Red-backed Vole		○	○	○	○	downed woody debris
Meadow Vole	●					fields, grassy meadows
Marten						
Woodland Caribou (winter)						
Woodland Caribou (hab. rank)						
White-tailed Deer (forage)	●	●			●	
White-tailed Deer (cover)						
Moose (forage)	●	●	○	○	○	
Moose (cover)			○	○	○	

○ Used Habitat ● Preferred Habitat

Successional Relationships - Natural

These stands are dominated by black ash in the canopy, usually forming pure stands. The sites are moist-wet, very nutrient rich, and characterized by fine-textured, mildly acidic, organic-enriched soils. The water tables is usually less than 2 m from the surface. Young stands are most similar to NWO FEC vegetation type V2 (and rarely V3). Older stands are also similar to V2, but some may succeed towards V21 dominated by eastern white cedar when depth to the water table is greater than 2 m and soil pH is neutral to slightly basic. Stands on this ecosite condition will range in age from 59 to 160 years.

This ecosite is dominated by black ash in the canopy, usually forming pure stands. White birch and balsam poplar are occasional canopy codominants. The lower sub-canopy and sapling layers are dominated by black ash, although balsam fir and white spruce may be frequent in older stands. Balsam poplar, white birch, trembling aspen and eastern white cedar occur occasionally beneath canopy gaps.

Tall shrubs occur frequently with a high degree of cover. Mountain maple and speckled alder are commonly encountered with mountain maple remaining a significant component of the shrub layer at older ages. *Ribes* spp. occur across this ecosite but usually with a low degree of cover. Ericaceous shrubs are absent from older stands.

Herb species richness and total cover are high while the number of percent cover of moss species remains low to moderate at all ages. The understorey is dominated by flood-tolerant, nutrient-loving herbaceous species. The herb layer of older stands remains species-rich but total cover declines through time. In general, species richness, diversity and evenness decline over time. Younger stands are dominated by *Carex disperma, Carex vaginata, Galium triflorum, Rubus pubsecen, Cirsium arvense, Thalictricum* spp. and *Equisteum* spp. while older stands are dominated by *Calamagrostis canadensis* and *Onoclea sensibilis.*

Over time these stands become more open, multi-tiered and uneven-aged. Total tree cover begins to decline after age 100 years. Black ash regenerates well through coppice and seed and continues to dominate the canopy - sub-canopy of older stands. White elm and red maple are also occasionally encountered in areas bordering Minnesota and Manitoba. Herbivory by white-tailed deer and beavers may influence the quality and abundance of black ash reproduction on any site. Spring and early summer flooding will also influence the dynamics of black ash stands. Regeneration declines as flooding frequency and duration increases.

The density and percent cover of white birch, balsam poplar declines through time and in the absence of catastrophic disturbance whereas eastern white cedar and white spruce increase in frequency and percent cover. In less flood prone sites, black ash may be succeeded by eastern white cedar. Balsam fir also increases over time but it is usually found only in the older stands.

Successional Relationships - Post-harvest

Response following harvest:

Black ash will regenerate from coppice following winter logging if some degree of canopy closure is retained using the Selection System. It is important to remove the more shade tolerant late successional species such as balsam fir and balsam poplar to ensure that their presence is not increased on the site. Clearcutting results in ‘wetting up’ of the site and reduces the amount of black ash regeneration . Disruption of surface and sub-surface water movement by rutting and compaction from harvesting equipment will adversely affect the renewal of black ash.

Response following harvest and mechanical site preparation:

Mechanical site preparation is not required for the reproduction of black ash managed under a Selection System on these ecosites.

Response following harvest and prescribed fire:

No information available.

Site Productivity

Site Index by species and NWO FEC Soil Type
Site Index (breast height age 50 years)

Soil Type	Species		
	Sb	Pj	Po
S5	16.8	N/A	20.3
S6	12.8	17.3	19.3
S10	10.0	17.0	22.8
S4	13.8	21.2	21.4

Black Spruce Advance Regeneration

	Vegetation Type
	V2
Stocking (%)	N/A
Stocking Range	N/A
Stems per ha	N/A

Black ash vegetation type V2 was not surveyed for black spruce advance growth. Due to the low density of black spruce in this V-type, the abundance of advance growth is assumed to be low.

Natural Ingress Probability and Density (ten years post-disturbance)

No information available

Critical Comments

- Coppice regeneration of balsam poplar, aspen,and black ash abundant.
- Moderate levels of woody shrub and hardwood tree competition from mountain maple, speckled alder, red raspberry, and balsam fir should be expected. *Calamagrostis canadensis* and seedling balsam fir is often abundant following harvest when excessive amounts of soil are disturbed.
- Excessive mineral soil exposure may lead to soil baking and/or frost heaving of young seedlings.

Site Characteristics, Limitations and Hazard Potential

Characteristics							Limitations				Hazard Potential				
LFH Layer	Soil Texture	Depth to Bedrock	Stoniness	Moisture Regime	Terrain	Competition	Windthrow	Frost Heaving	Drought/Desiccation	Seasonal Flooding	Compaction	Rutting	Soil Erosion	Biomass & Nutrient Removal	Silvicultural Activities
1	1,2			3	2					5	3	2	1,2		Harvesting
1	1,2			3	2	1,4		1		5	3	2	1,2		Renewal
	1,2					1,4				5					Tending

Footnotes:

1. Disturbance of the forest floor on fine textured soils will promote competitors and increase potential for erosion and frost heaving.
2. Soil erosion hazard increases with silt content. Hazard is moderate to high on slopes greater than ten percent.
3. Fine textured soils are susceptible to compaction and rutting when saturated during the frost free period.
4. Very high competition. Mountain maple, beaked hazel, aspen and blue-joint grass are the principle competitors.
5. Seasonal flooding may limit access and equipment operability.

Opportunities

- This ecosite can also be managed to support forests dominated by white spruce, black ash, american elm, balsam poplar and balsam fir.

Silvicultural Intensity Considerations

Species Objective	Site Productivity	Degree of Effort to Reach Free-to-grow
Black spruce	1	3
Jack pine	1	3
Aspen	1	1

Degree of Effort

1 = Extensive
2 = Basic
3 = Intensive
4 = Highly Intensive

Site Productivity - Site Productivity class (prime land productivity class) based upon height of dominant trees at age 50 years (breast height).

Silvicultural Interpretations for the Establishment of Black Spruce

Silvicultural System **• Harvest Method**		**Comments**
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	R	Residual stand will not contribute seed of sufficient quantity or genetic quality. However, this cutting technique may be prescribed to meet other management objectives.
- Patch	R	See Strip/Block comment.
- Seed-tree	NR	Potential for natural seeding is very low due to infrequent occurrence of black spruce in the original stand.
Shelterwood	NR	Black spruce is mid-tolerant and susceptible to windthrow after thinning of closed canopy stands.
Selection	NR	See Shelterwood comment.
Logging Method		Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season.
Full-tree	R	
Tree-length	R	Slash remaining on site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	R	See Tree-length comment.
Renewal Treatments		
Site Preparation		High competition on this site
• Mechanical	CR	Techniques, timing and sequencing of treatments should be carefully considered. Minimize mineral soil exposure on clays to reduce the incidence of soil baking and/or frost heaving, and to prevent increased competition from non-crop vegetation on a mixed mineral/organic microsite. Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season. Chemi-mechanical site preparation should be considered. Potential for standing dead and down woody debris resulting from repeat spruce budworm infestation is high and will affect equipment operability and effectiveness.
• Chemical	R	Some herbicide-resistant non-crop species may occur on this site.
• Prescribed Burn	R	Severity of burn will affect vegetation response. Fire will be beneficial for reduction of standing dead and down woody debris and associated heavy slash loads.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Black Spruce (con't)

Renewal Treatments	Comments	
Regeneration • Natural - Advance Growth	NR	Insufficient data exist. Vegetation types imply low levels of black spruce advance growth on this site.
- Seed	NR	Potential for natural seeding is very low due to infrequent occurrence of black spruce in the original stand.
- Vegetative (coppice)	NR	Black spruce does not coppice.
• Artificial - Planting	R	Plant close to the mineral/organic interface.
- Seeding	NR	Reduced seeding success on clay soils. Smothering of seedbeds with hardwood litter will further limit success. In addition, the distribution, abundance and vigour of competitive non-crop vegetation precludes the survival and growth of seed origin black spruce.
- Scarification	NR	Cone loading is low due to low density of black spruce in the original stand.
Tending Treatments		
Cleaning		High competition on this site.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing is usually not necessary since black spruce natural regeneration is minimal.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine

Silvicultural System **• Harvest Method**		**Comments**
Clearcut		
• Harvest Method		
- Conventional	R	
- Strip/Block	R	Residual stand will not contribute seed of sufficient quantity or genetic quality. However, this cutting technique may be prescribed to meet other management objectives.
- Patch	R	See Strip/Block comment.
- Seed-tree	NR	Potential for natural seeding is very low due to infrequent occurrence of jack pine in the original stand.
Shelterwood	NR	Jack pine is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season.
Full-tree	R	
Tree-length	R	Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	R	See Tree-length comment.
Renewal Treatments		
Site Preparation		High competition on this site.
• Mechanical	R	Techniques, timing and sequencing of treatments should be carefully considered. Minimize mineral soil exposure on clays to reduce the incidence of soil baking and/or frost heaving, and to prevent increased competition from non-crop vegetation on a mixed mineral/organic microsite. Fine-textured soils are susceptible to rutting and compaction when saturated during the frost free season. Chemi-mechanical site preparation should be considered. Potential for standing dead and down woody debris resulting from repeat spruce budworm infestation is high and will affect equipment operability and effectiveness.
• Chemical	R	Some herbicide-resistant non-crop species may occur on this site.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine (con't)

Renewal Treatments	Comments	
• Prescribed Burn	R	Severity of burn will affect vegetation response. Fire will be beneficial for reduction of standing dead and down woody debris and associated heavy slash loads.
Regeneration • Natural - Advance Growth	NR	Jack pine does not regenerate under a closed canopy.
- Seed	NR	Potential for natural seeding is very low due to infrequent occurrence of jack pine in the original stand.
- Vegetative (coppice)	NR	Jack pine does not coppice.
• Artificial - Planting	R	Plant close to the mineral/organic interface.
- Seeding	NR	Smothering of seedbeds with hardwood litter will limit success. In addition, the distribution, abundance and vigour of competitive non-crop vegetation precludes the survival and growth of seed origin jack pine.
- Scarification	NR	Cone loading is low due to low density of jack pine in the original stand. Cone scattering will give variable results. High competition on this site.
Tending Treatments		
Cleaning • Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing is usually not necessary since jack pine natural regeneration is minimal.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Aspen

Silvicultural System **• Harvest Method**	**Comments**	
Clearcut		
• Harvest Method		
- Conventional	R	
- Strip/Block	CR	Strips should be at least 20 m wide to warm the soil and stimulate suckering. Strip cutting can also be prescribed to meet other management objectives.
- Patch	CR	Openings 0.4 ha in size are the minimum acceptable to stimulate aspen suckering. Patch cutting can also be prescribed to meet other management objectives.
- Seed-tree	NR	Leaving live aspen will reduce suckering.
Shelterwood	NR	Aspen is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season.
Full-tree	R	
Tree-length	R	Slash remaining on the site will reduce soil temperature and sucker production.
Cut-to-length/Shortwood	R	See Tree-length comment. Concentration of slash in rows by single grip harvesters will create an uneven distribution of aspen suckers.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

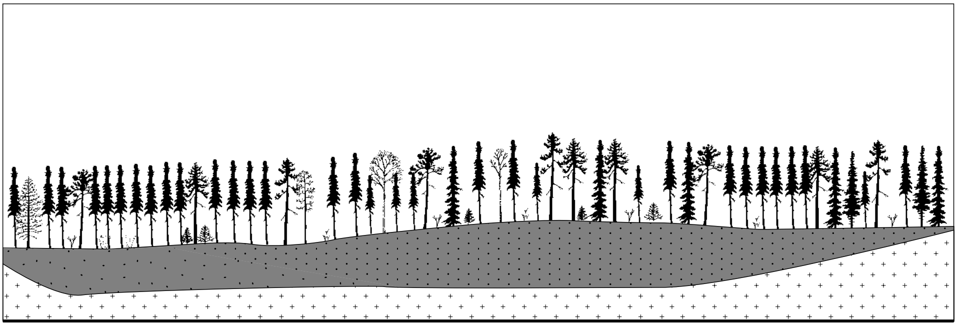
Silvicultural Interpretations for the Establishment of Aspen (con't)

Renewal Treatments		**Comments**
Site Preparation • Mechanical	NR	See Scarification (Section II, Book I).
• Chemical	R	Chemical site preparation may be used on sites where the residual overstorey will negatively affect root suckering. 2,4-D is recommended since it will remove the overstorey without damaging the aspen root systems.
• Prescribed Burn	R	
Regeneration • Natural - Advance Growth	NR	Aspen does not regenerate under a closed canopy.
- Seed	NR	Aspen regeneration from seed is highly variable.
- Vegetative (coppice)	R	
• Artificial - Planting	NR	Insufficient data and/or field experience exist to recommend this technique. Planting of aspen seedlings may be considered when existing aspen has deteriorated to a point where vegetative regeneration is unlikely or undesirable.
- Seeding	NR	Insufficient data and/or field experience exist to recommend this technique.
- Scarification	R	Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season.
Tending Treatments		
Cleaning		High competition on this site. High initial densities and rapid early growth of aspen suckers will ensure their successful renewal.
• Manual	NR	
• Mechanical	NR	
• Chemical - Ground	NR	
- Aerial	NR	
Spacing	R	Site quality and timing is critical for the success of this treatment.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Spruce–Pine / Feathermoss: Moist, Silty–Clayey Soil

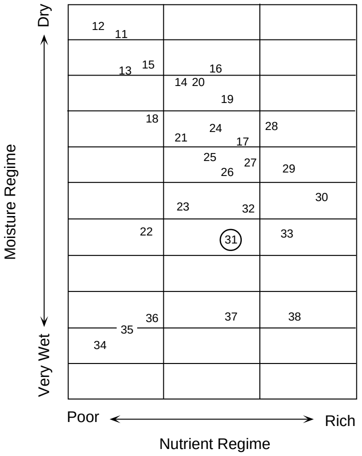
ES 31



approximately 250 m

General Description

Overstory dominated by black spruce and jack pine. Scattered occurrences of trembling aspen, white birch, balsam poplar, white spruce and balsam fir. Shrub- and herb-poor. Soils moist, silty to clayey textured. Developed primarily on lacustrine parent materials. Ground cover consists of feathermoss, conifer litter and wood, with *Sphagnum* patches in wetter locations.



Soil Types
S9, S10, SS7, SS8

Mode of Deposition
lacustrine, morainal

Humus Form
fibrimor, humifibrimor

Overstorey
black spruce, jack pine, trembling aspen, white birch, balsam poplar, balsam fir, white spruce

Shrubs/Trees (<10 m)
black spruce, balsam fir, *Alnus incana, Rubus pubescens, Vaccinium spp., Gaultheria hispidula, Ledum groenlandicum*

Herbs and Graminoids
Clintonia borealis, Aralia nudicaulis, Coptis trifolia, Maianthemum canadense, Cornus canadensis

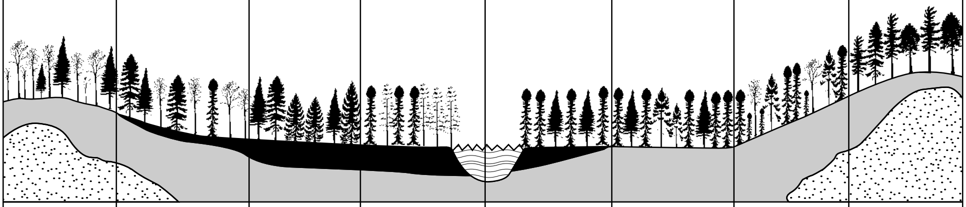
Mosses and Lichens
Pleurozium schreberi, Ptilium crista-castrensis, Hylocomium splendens, Sphagnum girgensohnii

Comments

Relatively uniform ecosite consisting of characteristic V-types V31, V32 and V33. Grades to V34 on toe slopes and depressions, often reflecting a telluric influence. Moister soil conditions contribute to a more diverse overstory. Expect V34 where ecosite grades with ES35 or ES36 and V19, and V20 where occasional patches of hardwood occur. Soils grade to peaty phase S11 and SS9.

Typical Landscape Associations

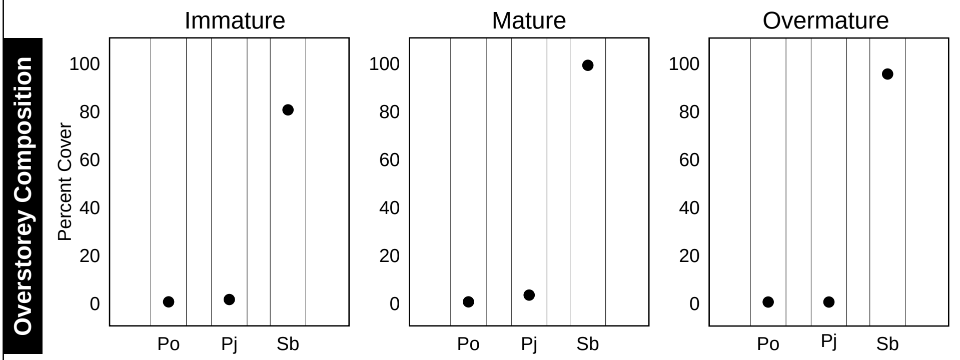
Typical Ecosite Sequence on Silty to Clayey Glaciolacustrine and Alluvial Material

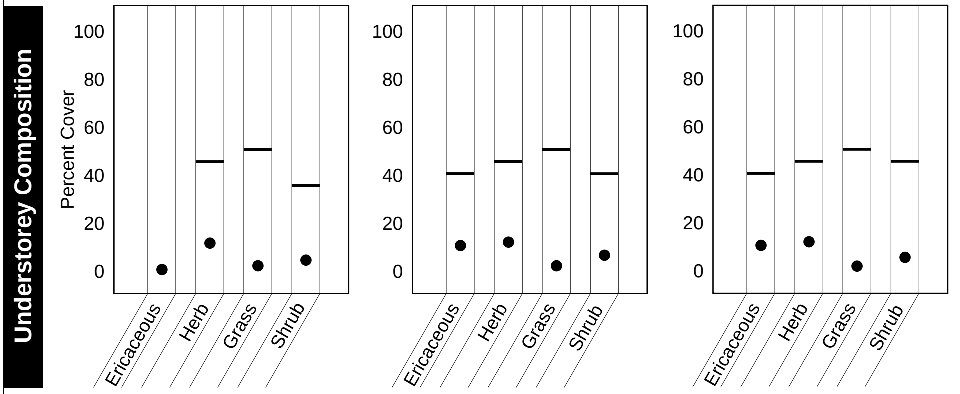


Po (Bw-Bf)	Po-Sw-Bw (Sb-Bf)	Ce-Bf-Sw	L-Sb	Sb (Bf)	Sb (Bf-Pj)	Sb-Pj (Po-Bw)	Pw-Pr (Bw)
ES28 Hardwood-Fir-Spruce Mixedwood: Fresh, Silty Soil	ES33 Hardwood-Fir-Spruce Mixedwood: Moist, Silty-Clayey Soil	ES37 Rich Swamp: Cedar (Other Conifer): Organic Soil	ES36 Intermediate Swamp: Black Spruce (Tamarack): Organic Soil	ES31 Spruce-Pine/ Feathermoss: Moist, Silty-Clayey Soil	ES25 Pine-Spruce/ Feathermoss: Fresh, Silty Soil	ES26 Spruce-Pine/ Feathermoss: Fresh, Fine Loamy-Clayey Soil	ES24 Red Pine-White Pine: Fresh, Fine Loamy Soil
V5 Aspen Hardwood	V9 Trembling Aspen Mixedwood	V21 Cedar (inc. Mixedwood)/ Mountain Maple	V23 Tamarack (Black Spruce)/ Speckled Alder/ Labrador-tea	V34 Black Spruce/ Labrador-tea/ Feathermoss (Sphagnum)	V31 Black Spruce-Jack Pine/ Tall Shrub/ Feathermoss	V32 Jack Pine-Black Spruce/ Ericaceous Shrub/ Feathermoss	V26 White Pine Conifer
S4 Fresh/Silty-Silt Loamy	S9 Moist/Silty-Silt Loamy	S12F Wet/Organic (Sphagnum)	S12S Wet/Organic (Sphagnum)	S10 Moist/Fine Loamy-Clayey	S4 Fresh/Silty-Silt Loamy	S5 Fresh/Fine Loamy	SS7 Moist/Sandy
Fresh	Moist	Wet	Wet	Moist	Fresh	Fresh	Fresh

Site Structure and Composition

Forest Stage





Advance Growth	Immature		Mature		Overmature	
	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)
Sb	0	N/A	2257	N/A	2917	N/A
Bf	0	N/A	6917	N/A	417	N/A

Seedbed	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen
	3	31	0	65	1	3	31	0	65	1	3	31	0	65	1

Coarse Woody Debris	Logs	Debris	Logs	Debris	Logs	Debris
	N/A	N/A	N/A	N/A	N/A	N/A

Vegetation and Soil Type Relationships

(number of plots with defined combinations)

Description of Soil and Vegetation

▒ Characteristic Common
■ Common Inclusions
□ Characteristic Uncommon

31 Black Spruce – Jack Pine / Tall Shrub / Feathermoss	32 Jack Pine – Black Spruce / Ericaceous Shrub / Feathermoss	33 Black Spruce / Feathermoss	34 Black Spruce / Labrador Tea / Feathermoss (Sphagnum)		
□	□	▒	▒		
3	4	4	1	▒	S9 – Moist / Silty – Silt Loamy
6	1	3	5	▒	S10 – Moist / Fine Loamy – Clayey
3	3	2	2	□	SS7– Shallow – Moderately Deep / Silty – Fine Loamy – Clayey
3	9	11	3	□	SS8 – Shallow – Moderately Deep / Mottles – Gley
			8	■	S11 – Moist / Peaty Phase

Selected Species Habitat Use

Species	Forest Stage					Special Habitat Preferences
	Pre-sapling	Sapling	Immature	Mature	Overmature	
Spruce Grouse			○	○	○	
Great Grey Owl				●	●	tamarack bogs preferred for nesting (use nests of other raptors)
Black-backed Woodpecker				○	○	snags
Pileated Woodpecker						
Least Flycatcher				●	●	often found near open spaces (edge, riparian)
Boreal Chickadee				●	●	snags
Swainson's Thrush			○	○	○	
Nashville Warbler		○	○	○		high level of light penetration, preferably with shallow undergrowth
Connecticut Warbler	○	○				nests in spruce bogs/tamarack fens with well developed understorey
White-throated Sparrow	○	○			○	numerous openings with low dense vegetation
Northern Flying Squirrel				○	○	snags
Southern Red-backed Vole		○	○	●	●	downed woody debris
Meadow Vole	○					fields, grassy meadows
Marten			○	●	●	snags, downed woody debris
Woodland Caribou (winter)				○	○	arboreal lichens
Woodland Caribou (hab. rank)			●	●	●	
White-tailed Deer (forage)	○	○				
White-tailed Deer (cover)						
Moose (forage)	○	○				
Moose (cover)			●	●	●	

○ Used Habitat ● Preferred Habitat

Successional Relationships - Natural

This ecosite is characterized by a mixed jack pine - black spruce canopy often containing trembling aspen, white birch, balsam poplar, balsam fir and white spruce in later successional stages. Jack pine is almost exclusively found in the canopy, whereas black spruce is distributed throughout the canopy, sub-canopy and sapling layers. White birch, trembling aspen and/or white spruce are often present in the upper two canopies as well as in the sapling layer. Total tree cover are high, and shrub and herb cover generally low. Stand ages range from 41 to 242 years with the majority of sites occurring between 50 to 100 years of age.

Total shrub cover is low, and ericaceous shrubs are ubiquitous (mainly *Vaccinium* spp., *Gaultheria hispidula*, *Ledum groenlandicum* and *Rosa acicularis*). *Ledum groenlandicum* is often present on moist sites and generally occurs at moderate to high cover. Tall shrubs are relatively uncommon although *Alnus incana* can be abundant in seepage or mid-slope positions. Non-ericaceous shrubs and herbs occur with low frequency and/or cover. The forest floor is primarily covered by *Pleurozium schreberi* although *Dicranum polysetum*, *Ptilium crista-cristensis* and *Hylocomium splendens* are also frequent. Species richness, diversity and evenness are low compared to the other ecosites.

The successional trajectory indicates increased dominance by black spruce, in both the canopy and sub-canopy layers. Black spruce recruitment into the stand terminates following crown closure. Recruitment of black spruce is initially contemporaneous with jack pine and then becomes gradual or episodic. Episodic recruitment usually follows low-intensity surface fire.

White birch which may show moderate to strong regeneration in more open canopy sites and/or in areas of windthrow, persists in some older stands. Balsam fir regenerates well in the understorey beginning at or about 30 years of age provided a seed source is nearby. On ES31 balsam fir may reach the canopy layer. A slight increase in tree level diversity occurs at older ages reflecting the higher frequency of white birch, trembling aspen and balsam fir.

Tall and low shrub cover will decline over time after 100 years as canopy closure is maintained. Herb cover declines steadily. Moss species continue to dominate the forest floor. Total herb cover is generally less than that of shrubs and also declines, particularly in older stands.

Successional Relationships - Post-harvest

Response following harvest:

The presence of a viable black spruce or jack pine seed source from residuals or adjacent stands will contribute to the perpetuation of those species on this ecosite. Jack pine in the original stand will make the likelihood of jack pine ingress greater. An aspen component present in the original canopy is likely to be maintained through vegetative suckering while birch will be maintained through seed origin reproduction. Both hardwood species increase in abundance following harvest.

ES31 has a high probability for natural ingress of all three tree species. Jack pine ingress will exist even on undisturbed ground due to the moist soil conditions. Full and 50 percent ingress are achieved approximately five and three years after harvest, respectively.

A moderate probability exists for black spruce advance growth to occur in the understorey in the undisturbed stand. Stocking of black spruce and balsam fir in the sub-canopy or as advance growth in the understorey will be greatly reduced following canopy removal due to exposure, sunscald and increased droughtiness of the site.

Proliferation of herbs and low woody shrubs is common. Exposed feathermoss quickly dies following removal of the overstorey.

Response following harvest and mechanical site preparation:

Disturbance and mixing of the LFH with mineral soil will create suitable seedbed for black spruce and jack pine. If jack pine is present in the original stand, its presence in the future stand may be enhanced by scarification on the site.

Soil disturbance will stimulate the establishment and growth of woody shrubs and will stimulate hardwood suckering especially from aspen. Mechanical site preparation and the exposure or mixing of mineral and organic soils will greatly stimulate the establishment of grasses and wild raspberry. Retention of an intact forest floor condition will reduce non-crop species on site.

Response following harvest and prescribed fire:

Following fire, the growth of trembling aspen, ericaceous shrubs (blueberry) and herbs is stimulated. These species can quickly dominate the site within two years. Moderate to high intensity surface fires will be effective in reducing future competition from woody shrubs but will result in a less-than-favorable exposed mineral soil seedbed suitable for conifer establishment. Prescribed fire will destroy any black spruce or balsam fir advance growth and will usually girdle any seedling jack pine. Moderate to severe intensity surface fires will completely remove the surface organic horizons and kill any hardwood shrubs or aspen present on the cutover.

Site Productivity

Site Index by species and NWO FEC Soil Type

Site Index (breast height age 50 years)

Soil Type	Species		
	Sb	Pj	Po
S9	15.4	18.0	21.8
S10	10.0	17.0	22.8
SS7	13.7	14.2	22.2
SS8	15.3	16.8	17.2
S11	12.0	N/A	Non-productive

Black Spruce Advance Regeneration

	Vegetation Type		
	V31	V33	V34
Stocking (%)	19	24	40
Stocking Range	0 – 55	0 – 95	0 – 90
Stems per ha	100	2500	3100

V31 is the characteristic vegetation type with V33 and V34 as common inclusions.

This ecosite is dominated by black spruce and jack pine with scattered stems of other species.

Where black spruce dominates the original stand, there is a moderate possibility of advance growth being present in numbers and distribution to regenerate the site.

The number and distribution of black spruce advance growth on this ecosite is positively related to:

- basal area of black spruce in the original stand
- percent cover of sphagnum moss or Labrador-tea

and inversely related to:

- percent cover of herbaceous species
- percent cover of broadleaf litter
- percent canopy closure

Natural Ingress Probability and Density (ten years post-disturbance)

Seedbed Condition	Species and Height Class					
	Sb		Pj		Po	
	< 1.0	> 1.0	< 1.0	> 1.0	< 1.0	> 1.0
Duff	X ▓	H ░	H ▓	X ▇	X ▒	X ▒
Mineral Soil	Insufficient Data					
Burned	Insufficient Data					

Probability Class

V- < 21%
L- 21 - 40%
M- 41 - 60%
H- 61 - 80%
X- > 80%

Density Class

░	< 300
▒	300 - 1000
▓	1001 - 5000
▇	5001 - 10000
█	> 10000

- Jack pine ingress dominates this ecosite in the overstorey. Black spruce is the dominant species in the understorey.
- 50 percent ingress is achieved within three years for all three major species.
- Full ingress occurs most quickly for black spruce at five years after disturbance.
- Jack pine density is surprisingly high for unscarified conditions. Perhaps seedbed conditions for jack pine germination are enhanced (compared to dry feathermoss sites) because the feathermoss on this ecosite is kept moist in the spring due to a low percolation of snowmelt through the underlying heavy-textured soil.

Critical Comments

- Low to moderate competition may be expected from white birch and aspen (where it exists in the original stand).
- Disturbance of the LFH and surface mineral soil during harvesting operations may lead to a proliferation of red raspberry and Calamagrostis canadensis.
- Exposure of surface mineral soil may lead to soil baking and/or frost heaving of regenerating seedlings.
- Ecosites supporting V30, V31, V32, V33, are moderately susceptible to spruce budworm infestation.
- Natural regeneration of black spruce limited by available local seed supply and lack of suitable supply and duration of receptive seedbed and smothering from hardwood litter.

Site Characteristics, Limitations and Hazard Potential

Characteristics								Limitations			Hazard Potential				
LFH Layer	Soil Texture	Depth to Bedrock	Stoniness	Moisture Regime	Terrain	Competition	Windthrow	Frost Heaving	Drought/Desiccation	Seasonal Flooding	Compaction	Rutting	Soil Erosion	Biomass & Nutrient Removal	Silvicultural Activities
1	1,3			4	3						4	4	1,3		Harvesting
1,2	1,3			4	3	1	5	1			4	4	1,3		Renewal
	1,3					1									Tending

Footnotes:

1. Disturbance of the forest floor on fine textured soils will promote non-crop vegetation and increase the potential for erosion and frost heaving.
2. LFH layer is a poor seedbed.
3. Soil erosion hazard increases with silt content. Hazard is moderate to high on slopes greater than ten percent.
4. Fine textured soils are susceptible to compaction and rutting when saturated during the frost free period.
5. Potential for windthrow of shallow rooted species on moist, fine textured soils.

Opportunities

- Telluric water on mid- and toe-slope positions makes this ecosite highly productive for all tree species.
- High levels of jack pine and black spruce ingress after disturbance, coupled with moderate levels of black spruce advance growth make this ecosite an attractive candidate for natural regeneration treatments.
- Modified clearcuts (strips and/or blocks) are highly successful at promoting natural regeneration of black spruce onto the site.
- Creating receptive seedbed through fire or mechanical site preparation is necessary for natural or artificial seeding of pine or spruce. Compacted moist feathermoss will also serve as a seedbed on these ecosites.
- Jack pine and black spruce seed trees (minimum 20/ha) in conjunction with prescribed fire offers a cost-effective regeneration strategy on these sites.

Silvicultural Intensity Considerations

Species Objective	Site Productivity	Degree of Effort to Reach Free-to-grow
Black spruce	1 – 2	3
Jack pine	1 – 2	2 – 3
Aspen	1	1

Site Productivity - Site Productivity class (prime land productivity class) based upon height of dominant trees at age 50 years (breast height).

Degree of Effort

1 = Extensive
2 = Basic
3 = Intensive
4 = Highly Intensive

Silvicultural Interpretations for the Establishment of Black Spruce

Silvicultural System **• Harvest Method**		**Comments**
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	R	Good potential for natural seeding from spruce dominated residual stands. May require supplemental artificial regeneration.
- Patch	R	See Strip/Block comment.
- Seed-tree	R	Group seed trees is the most commonly used technique. Good potential for seeding from group seed trees. Individual seed tree to be used only in conjunction with prescribed fire. Ensure there is adequate distribution of black spruce in the portion of the stand where seed tree system is being prescribed. May require supplemental artificial regeneration.
Shelterwood	NR	Black spruce is mid-tolerant and susceptible to windthrow after thinning of closed canopy stands.
Selection	NR	See Shelterwood comment.
Logging Method		Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season. Harvest on frozen ground or use low-impact equipment when soils are saturated.
Full-tree	CR	See Logging Method comment.
Tree-length	CR	See Logging Method comment. Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	CR	See Tree-length comment.
Renewal Treatments		
Site Preparation		Low competition on this site. Aspen, white birch, raspberry and blue-joint grass may be locally abundant.
• Mechanical	CR	Techniques, timing and sequencing of treatments should be carefully considered. Minimize mineral soil exposure on clays to reduce the incidence of soil baking and/or frost heaving, and to prevent increased competition from non-crop vegetation on a mixed mineral/organic microsite. Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season.
• Chemical	R	Some herbicide-resistant non-crop species may occur on this site.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Black Spruce (con't)

Renewal Treatments	Comments	
• Prescribed Burn	CR	Prescribed fire may be used where advance growth is inadequate.
Regeneration • Natural - Advance Growth	R	Moderate levels of advance growth. May require supplemental artificial regeneration.
- Seed	NR	Low levels of black spruce ingress.
- Vegetative (coppice)	NR	Black spruce does not coppice.
• Artificial - Planting	R	Plant close to the mineral/organic interface.
- Seeding	CR	Moderate potential for aerial seeding. Reduced seeding success on clay soils and results will be poor. An abundant supply of seed from slash is necessary to supplement the aerial seeding. Site preparation is required to create sufficient suitable seedbed. Competition must be controlled.
- Scarification	NR	Low levels of black spruce ingress.
Tending Treatments		
Cleaning		Low competition on this site and cleaning is usually not required.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing will be beneficial where density is high from natural or direct seeding.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine

Silvicultural System • **Harvest Method**		**Comments**
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	R	Residual stand will not contribute seed of sufficient quantity or genetic quality. However, this cutting technique may be prescribed to meet other management objectives.
- Patch	R	See Strip/Block comment.
- Seed-tree	NR	Insufficient data and/or field experience exist to recommend this technique.
Shelterwood	NR	Jack pine is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season. Harvest on frozen ground or use low-impact equipment when soils are saturated.
Full-tree	CR	See Logging Method comment.
Tree-length	CR	See Logging Method comment. Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	CR	See Tree-length comment.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine (con't)

Renewal Treatments	Comments	
Site Preparation		Low competition on this site. Aspen, white birch, raspberry and blue-joint grass may be locally abundant.
• Mechanical	CR	Techniques, timing and sequencing of treatments should be carefully considered. Minimize mineral soil exposure on clays to reduce the incidence of soil baking and/or frost heaving, and to prevent increased competition from non-crop vegetation on a mixed mineral/organic microsite. Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season.
• Chemical	R	Some herbicide-resistant non-crop species may occur on this site.
• Prescribed Burn	R	Severity of burn will affect vegetation response.
Regeneration • Natural - Advance Growth	NR	Jack pine does not regenerate under a closed canopy.
- Seed	R	High levels of jack pine ingress.
- Vegetative (coppice)	NR	Jack pine does not coppice.
• Artificial - Planting	R	Plant close to the mineral/organic interface.
- Seeding	R	Good distribution of mineral soil seedbeds will contribute to success.
- Scarification	NR	Insufficient data exist.
Tending Treatments		
Cleaning		Low competition on this site and cleaning is not usually required.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing will be beneficial where density is high from natural or direct seeding.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Aspen

Silvicultural System **• Harvest Method**		**Comments**
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	CR	Strips should be at least 20 m wide to warm the soil and stimulate suckering. Strip cutting can also be prescribed to meet other management objectives.
- Patch	CR	Openings 0.4 ha in size are the minimum acceptable to stimulate aspen suckering. Patch cutting can also be prescribed to meet other management objectives.
- Seed-tree	NR	Leaving live aspen will reduce suckering.
Shelterwood	NR	Aspen is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	CR	Harvest on frozen ground or use low-impact equipment when soils are saturated. Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season.
Tree-length	CR	See Logging Method comment. Slash remaining on the site will reduce soil temperature and sucker production.
Cut-to-length/Shortwood	CR	See Tree-length comment. Concentration of slash in rows by single grip harvesters will create an uneven distribution of aspen suckers.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

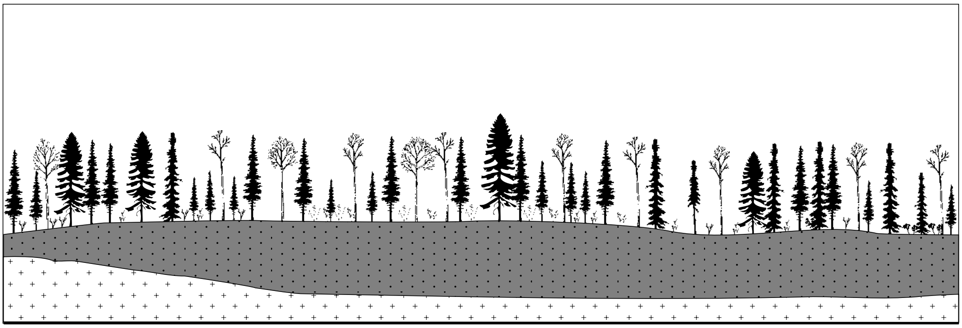
Silvicultural Interpretations for the Establishment of Aspen (con't)

Renewal Treatments	Comments	
Site Preparation		
• Mechanical	NR	See Scarification (Section II, Book I).
• Chemical	R	Chemical site preparation may be used on sites where the residual overstorey will negatively affect root suckering. 2,4-D is recommended since it will remove the overstorey without damaging the aspen root systems.
• Prescribed Burn	R	
Regeneration		
• Natural		
- Advance Growth	NR	Aspen does not regenerate under a closed canopy.
- Seed	NR	Aspen regeneration from seed is highly variable.
- Vegetative (coppice)	R	There may be insufficient aspen on this site to achieve management objectives.
• Artificial		
- Planting	NR	Insufficient data and/or field experience exist to recommend this technique. Planting of aspen seedlings may be considered when existing aspen has deteriorated to a point where vegetative regeneration is unlikely or undesirable.
- Seeding	NR	Insufficient data and/or field experience exist to recommend this technique.
- Scarification	CR	Apply treatment on frozen ground or use low -impact equipment. Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season.
Tending Treatments		
Cleaning		Generally low competition on this site. High initial densities and rapid early growth of aspen suckers will ensure their successful renewal on this site.
• Manual	NR	
• Mechanical	NR	
• Chemical		
- Ground	NR	
- Aerial	NR	
Spacing	R	Site quality and timing is critical for the success of this treatment.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

ES 32

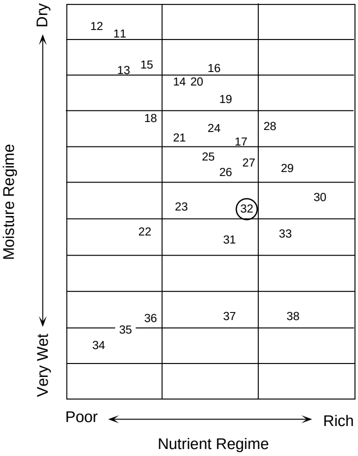
Fir–Spruce Mixedwood: Moist, Silty–Clayey Soil



approximately 250 m

General Description

Dominated by balsam fir, white spruce, trembling aspen and black spruce. Occasionally with white birch, jack pine and balsam poplar. Conifer component exceeds 50%. Moderately shrub- and herb-rich. Soils moist, silty to clayey. Developed primarily on lacustrine parent materials. Ground cover consists of broadleaf litter, conifer litter, feathermoss and wood.



Soil Types

S9, S10, SS8

Mode of Deposition

lacustrine, glaciofluvial

Humus Form

fibrimor, humifibrimor

Overstorey

balsam fir, white spruce, trembling aspen, black spruce, jack pine, white birch, balsam poplar

Shrubs/Trees (<10 m)

Rubus pubescens, Linnaea borealis, balsam fir, *Diervilla lonicera, Acer spicatum, Corylus cornuta, Alnus incana, Rosa acicularis, Ledum groenlandicum*

Herbs and Graminoids

Aralia nudicaulis, Streptopus roseus, Clintonia borealis, Coptis trifolia, Mitella nuda, Aster macrophyllus, Maianthemum canadense, Cornus canadensis

Mosses and Lichens

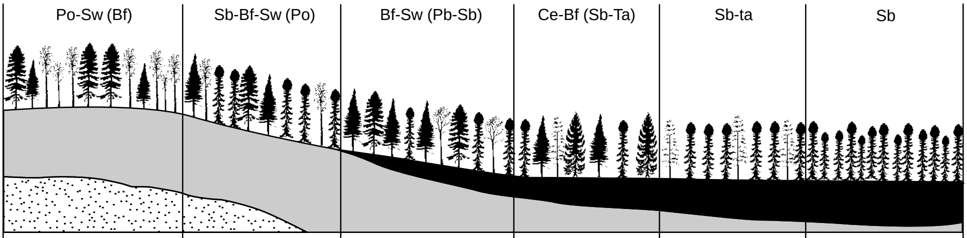
Pleurozium schreberi, Ptilium crista-castrensis, Sphagnum girgensohnii

Comments

Overstory composition variable. Characteristic V-types V14, V15 and V19 tend to be intermixed in some areas and relatively pure in others. Expect V22 to occur on rich sites in the vicinity of Atikokan, Fort Frances and Dryden. Soils often grade to peaty phase S11, or moderately deep organic SS9 in association with ES35, ES36 and ES37.

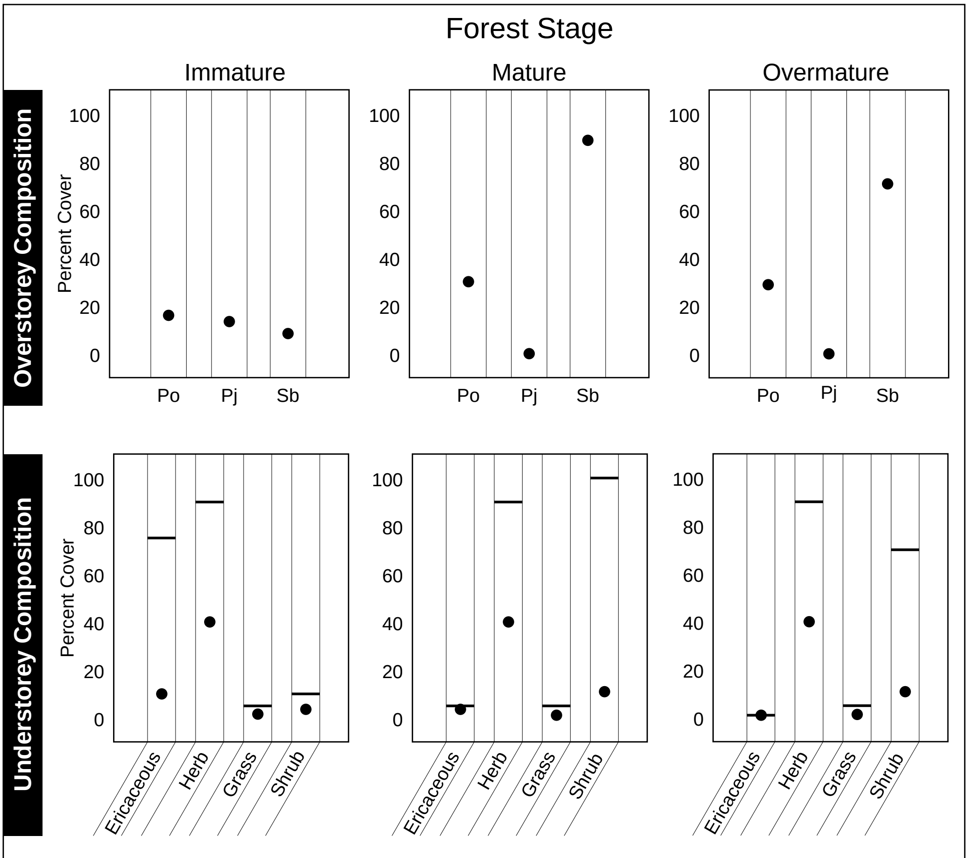
Typical Landscape Associations

Typical Ecosite Sequence on Deep Silty to Clayey Glaciolacustrine Material



ES29 Hardwood-Fir-Spruce Mixedwood: Fresh, Loamy-Clayey Soil	ES27 Fir-Spruce Mixedwood: Fresh, Silty-Fine Loamy Soil	ES32 Fir-Spruce Mixedwod: Moist, Silty-Clayey Soil	ES37 Rich Swamp: Cedar (Other Conifer): Organic Soil	ES36 Intermediate Swamp: Black Spruce (Tamarack): Organic Soil	ES35 Poor Swamp: Black Spruce: Organic Soil
V8 Trembling Aspen (White Birch)/ Mountain Maple	V16 Balsam Fir-White Spruce Mixedwood/ Feathermoss	V14 Balsam Fir Mixedwood	V22 Cedar (inc. Mixedwood)/ Speckled Alder/ Sphagnum	V23 Tamarack (Black Spruce)/ Speckled Alder/ Labrador-tea	V37 Black Spruce/ Ericaceous Shrub Sphagnum
S5 Fresh/ Fine Loamy	S6 Fresh/Clayey	S10 Moist/Fine Loamy-Clayey	S12F Wet/Organic (Feathermoss)	S12S Wet/Organic (Sphagnum)	S12S Wet/Organic (Sphagnum)
Fresh	Fresh	Moist	Wet	Wet	Wet

Site Structure and Composition



Advance Growth	Forest Stage					
	Immature		Mature		Overmature	
	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)
Sb	1858	N/A	764	N/A	981	N/A
Bf	1082	N/A	341	N/A	8	N/A

Seedbed															
	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen
	0	44	0	56	0	0	44	0	56	0	0	44	0	56	0

Coarse Woody Debris						
	Logs	Debris	Logs	Debris	Logs	Debris
	N/A	N/A	N/A	N/A	N/A	N/A

Vegetation and Soil Type Relationships
(number of plots with defined combinations)

Description of Soil and Vegetation
- ▨ Characteristic Common
- ■ Common Inclusions
- □ Characteristic Uncommon

14 Balsam Fir Mixedwood	15 White Spruce Mixedwood	19 Black Spruce Mixedwood / Herb Rich	22 Cedar (inc. Mixedwood) / Speckled Alder / Sphagnum		
▨	□	▨	□		
3		6		▨	S9 – Moist / Silty – Silt Loamy
5	3	5		▨	S10 – Moist / Fine Loamy – Clayey
1	1	3		□	SS8 – Shallow – Moderately Deep / Mottles – Gley
		3	1	■	S11 – Moist / Peaty Phase

Selected Species Habitat Use

	Forest Stage					
Species	Pre-sapling	Sapling	Immature	Mature	Overmature	Special Habitat Preferences
Spruce Grouse					○	
Great Grey Owl						
Black-backed Woodpecker						
Pileated Woodpecker						
Least Flycatcher				●	●	often found near open spaces (edge, riparian)
Boreal Chickadee				○	○	snags
Swainson's Thrush			○	○	○	
Nashville Warbler		○	○	○		high level of light penetration, preferably with shallow undergrowth
Connecticut Warbler						
White-throated Sparrow	○	○			○	numerous openings with low dense vegetation
Northern Flying Squirrel				○	○	snags
Southern Red-backed Vole		○	○	●	●	downed woody debris
Meadow Vole	○					fields, grassy meadows
Marten			○	●	●	snags, downed woody debris
Woodland Caribou (winter)						
Woodland Caribou (hab. rank)				○	○	
White-tailed Deer (forage)	●	●			○	
White-tailed Deer (cover)			○	○	○	
Moose (forage)	○	○				
Moose (cover)			●	●	●	

○ Used Habitat   ● Preferred Habitat

Successional Relationships - Natural

No information available

Successional Relationships - Post-harvest

Response following harvest:

No information available

Response following harvest and mechanical site preparation:

No information available

Response following harvest and prescribed fire:

No information available

Site Productivity

Site Index by species and NWO FEC Soil Type
Site Index (breast height age 50 years)

Soil Type	Species		
	Sb	Pj	Po
S9	15.4	18.0	21.8
S10	9.9	17.0	22.8
SS8	15.3	16.8	17.2
S11	12.0	N/A	Non-productive

Black Spruce Advance Regeneration

	Vegetation Type	
	V14	V19
Stocking (%)	N/A	23
Stocking Range	N/A	0 – 75
Stems per ha	N/A	1900

V14 is the characteristic vegetation type with V19 as a common inclusion.

Balsam fir, white spruce, trembling aspen and black spruce dominate the ecosite with other species present in varying proportions.

This ecosite has a low probability of sufficient number and distribution of black spruce advance growth to regenerate the site.

The number and distribution of black spruce advance growth on this ecosite is positively related to:

- basal area of black spruce in the original stand

and inversely related to:

- percent cover of herbaceous species
- percent cover of broadleaf litter
- percent canopy closure

Natural Ingress Probability and Density (ten years post-disturbance)

No information available

Critical Comments

- Heavy woody shrub and hardwood tree competition from mountain maple, speckled alder, beaked hazel, aspen and balsam fir should be expected. *Calamagrostis canadensis* and seedling balsam fir is often abundant following harvest when excessive amounts of soil are disturbed.
- High potential for windthrow of shallow rooted species such as black spruce.
- Stands are vulnerable to spruce budworm if the proportion of balsam fir and white spruce in the stands exceeds 20 percent of the total crown volume.
- Soil/site conditions limit the use of hexazinone products for chemical site preparation.
- Natural regeneration of black spruce and jack pine limited by available local seed supply and lack of suitable supply and duration of receptive seedbed and smothering from hardwood leaf litter.
- Natural regeneration heavily dominated by balsam fir.
- Extensive slash resulting from, dead and dying balsam fir, residual balsam fir and balsam fir advance growth will limit the effectiveness of intermittent patch scarifiers and passive disc-trenchers.

Site Characteristics, Limitations and Hazard Potential

Characteristics							Limitations				Hazard Potential				
LFH Layer	Soil Texture	Depth to Bedrock	Stoniness	Moisture Regime	Terrain	Competition	Windthrow	Frost Heaving	Drought/Desiccation	Seasonal Flooding	Compaction	Rutting	Soil Erosion	Biomass & Nutrient Removal	Silvicultural Activities
1	1,3			4	3						4	4	1,3		Harvesting
1,2	1,3			4	3	1,5	6	1			4	4	1,3		Renewal
	1,3					1,5									Tending

Footnotes:

1. Disturbance of the forest floor on fine textured soils will promote non-crop vegetation and increase potential for erosion and frost heaving.
2. LFH layer is a poor seedbed.
3. Soil erosion hazard increases with silt content. Hazard is moderate to high on slopes greater than ten percent.
4. Fine textured soils are susceptible to compaction and rutting when saturated during the frost free period.
5. High to very high competition. Mountain maple, beaked hazel, aspen, balsam fir and blue-joint grass are the principle competitors.
6. Potential for windthrow of shallow rooted species on moist, fine textured soils.

Opportunities

- This ecosite can also be managed to support forests dominated by balsam fir, white birch, and/or white spruce.
- Site quality for aspen growth and wood quality enhanced on this site, expecially where stone content approaches 30 percent and soils are calcareous.
- White spruce and black spruce seed trees, combined with site preparation for mineral soil exposure, can augment conifer regeneration levels.
- Use prescribed fire after harvest to eliminate dense balsam fir advance growth and create plantable spots or stimulate aspen suckering.
- Browse production potential is high, both before and after harvest.
- This ecosite may provide winter shelter for moose depending upon the habitat mosaic.
- Stands associated with this ecosite have a high degree of structural diversity contributing to their importance as potential habitat for small mammals, furbearers and a large number of songbirds.

Silvicultural Intensity Considerations

Species Objective	Site Productivity	Degree of Effort to Reach Free-to-grow
Black spruce	1 – 2	3
Jack pine	1 – 2	3
Aspen	1	1

Site Productivity - Site Productivity class (prime land productivity class) based upon height of dominant trees at age 50 years (breast height).

Degree of Effort

1 = Extensive
2 = Basic
3 = Intensive
4 = Highly Intensive

Silvicultural Interpretations for the Establishment of Black Spruce

Silvicultural System • Harvest Method		Comments
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	R	Residual stand will not contribute seed of sufficient quantity. However, this cutting technique may be prescribed to meet other management objectives.
- Patch	R	See Strip/Block comment.
- Seed-tree	NR	Potential for natural seeding is very low due to infrequent occurrence of black spruce in the original stand, lack of receptive seedbed and potential for competition.
Shelterwood	NR	Black spruce is mid-tolerant and susceptible to windthrow after thinning of closed canopy stands.
Selection	NR	See Shelterwood comment.
Logging Method		Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season. Harvest on frozen ground or use low-impact equipment when soils are saturated.
Full-tree	CR	See Logging Method comment.
Tree-length	CR	See Logging Method comment. Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	CR	See Tree-length comment.
Renewal Treatments		
Site Preparation		High to very high competition on this site.
• Mechanical	CR	Techniques, timing and sequencing of treatments should be carefully considered. Minimize mineral soil exposure on clays to reduce the incidence of soil baking and/or frost heaving, and to prevent increased competition from vegetation on a mixed mineral/organic microsite. Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season. Chemi-mechanical site preparation should be considered. Potential for standing dead and down woody debris resulting from repeat spruce budworm infestation is high and will affect equipment operability and effectiveness.
• Chemical	R	Some herbicide-resistant non-crop species may occur on this site.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Black Spruce (con't)

Renewal Treatments	Comments	
• Prescribed Burn	R	Severity of burn will affect vegetation response. Fire will be beneficial for reduction of balsam fir competition, standing dead and down woody debris and associated heavy slash loads.
Regeneration • Natural - Advance Growth	NR	Black spruce advance growth is not of sufficient quantity or distribution to regenerate the stand.
- Seed	NR	Site conditions imply potential for black spruce ingress is very low.
- Vegetative (coppice)	NR	Black spruce does not coppice.
• Artificial - Planting	R	Plant close to the mineral/organic interface.
- Seeding	NR	Seeding success is reduced on clay soils. Smothering of seedbeds with hardwood litter will further limit success. In addition, the distribution, abundance and vigour of non-crop vegetation precludes the survival and growth of seed origin black spruce.
- Scarification	NR	Site conditions imply potential for black spruce ingress is very low.
Tending Treatments		
Cleaning		High to very high competition on this site.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing is usually not necessary since black spruce natural regeneration is minimal.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine

Silvicultural System **• Harvest Method**		**Comments**
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	R	Residual stand will not contribute seed of sufficient quantity or genetic quality. However, this cutting technique may be prescribed to meet other management objectives.
- Patch	R	See Strip/Block comment.
- Seed-tree	NR	Potential for natural seeding is very low due to infrequent occurrence of jack pine in the original stand.
Shelterwood	NR	Jack pine is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season. Harvest on frozen ground or use low-impact equipment when soils are saturated.
Full-tree	CR	See Logging Method comment.
Tree-length	CR	See Logging Method comment. Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	CR	See Tree-length comment.
Renewal Treatments		
Site Preparation		High to very high competition on this site.
• Mechanical	CR	Techniques, timing and sequencing of treatments should be carefully considered. Minimize mineral soil exposure on clays to reduce the incidence of soil baking and/or frost heaving, and to prevent increased competition from non-crop vegetation on a mixed mineral/organic microsite. Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season. Chemi-mechanical site preparation should be considered. Potential for standing dead and down woody debris resulting from repeat spruce budworm infestation is high and will affect equipment operability and effectiveness.
• Chemical	R	Some herbicide-resistant non-crop species may occur on this site.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine (con't)

Renewal Treatments	**Comments**	
• Prescribed Burn	R	Severity of burn will affect vegetation response. Fire will be beneficial for reduction of balsam fir competition, standing dead and down woody debris and associated heavy slash loads.
Regeneration • Natural - Advance Growth	NR	Jack pine does not regenerate under a closed canopy.
- Seed	NR	Potential for natural seeding is very low due to infrequent occurrence of jack pine in the original stand.
- Vegetative (coppice)	NR	Jack pine does not coppice.
• Artificial - Planting	R	Plant close to the mineral/organic interface.
- Seeding	NR	Smothering of seedbeds with hardwood litter will limit success. In addition, the distribution, abundance and vigour of non-crop vegetation precludes the survival and growth of seed origin jack pine.
- Scarification	NR	Cone loading is low due to low density of jack pine in the original stand. Cone scattering will give variable results.
Tending Treatments		
Cleaning		High to very high competition on this site.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing is usually not necessary since jack pine natural regeneration is minimal.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Aspen

Silvicultural System **• Harvest Method**		**Comments**
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	CR	Strips should be at least 20 m wide to warm the soil and stimulate suckering. Strip cutting can also be prescribed to meet other management objectives.
- Patch	CR	Openings 0.4 ha in size are the minimum acceptable to stimulate aspen suckering. Patch cutting can also be prescribed to meet other management objectives.
- Seed-tree	NR	Leaving live aspen will reduce suckering.
Shelterwood	NR	Aspen is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	CR	Harvest on frozen ground or use low-impact equipment when soils are saturated. Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season.
Tree-length	CR	See Logging Method comment. Slash remaining on the site will reduce soil temperature and sucker production.
Cut-to-length/Shortwood	CR	See Tree-length comment. Concentration of slash in rows by single grip harvesters will create an uneven distribution of aspen suckers.
Renewal Treatments		
Site Preparation • Mechanical	NR	See Scarification (Section II, Book I).
• Chemical	R	Chemical site preparation may be used on sites where the residual overstorey will negatively affect root suckering. 2,4-D is recommended since it will remove the overstorey without damaging the aspen root systems.
• Prescribed Burn	R	

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

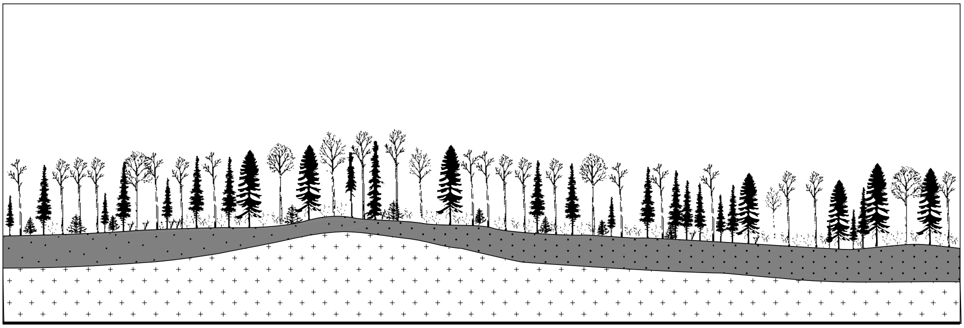
Silvicultural Interpretations for the Establishment of Aspen (con't)

Renewal Treatments	Comments	
Regeneration • Natural - Advance Growth	NR	Aspen does not regenerate under a closed canopy.
- Seed	NR	Aspen regeneration from seed is highly variable.
- Vegetative (coppice)	R	
• Artificial - Planting	NR	Insufficient data and/or field experience exist to recommend this technique. Planting of aspen seedlings may be considered where vegetative regeneration is unlikely or undesirable.
- Seeding	NR	Insufficient data and/or field experience exist to recommend this technique.
- Scarification	CR	Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season. Apply treatment on frozen ground or use low-impact equipment. Potential for standing dead and down woody debris resulting from repeat spruce budworm infestation is high and will affect equipment operability and effectiveness.
Tending Treatments		
Cleaning		High to very high competition on this site. High initial densities and rapid early growth of aspen suckers will ensure their successful renewal on this site.
• Manual	NR	
• Mechanical	NR	
• Chemical - Ground	NR	
- Aerial	NR	
Spacing	R	Site quality and timing is critical for the success of this treatment.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Hardwood–Fir–Spruce Mixedwood: Moist, Silty–Clayey Soil

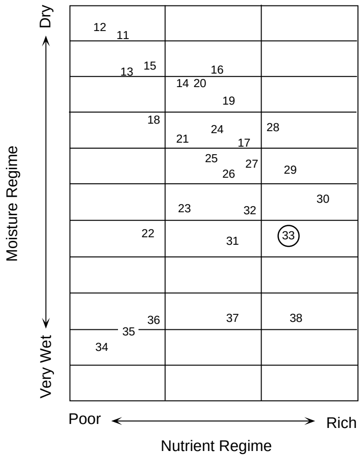
ES 33



approximately 250 m

General Description

Dominated by trembling aspen, white birch, balsam fir and white spruce. Occasionally with black spruce and balsam poplar. Conifer component less than 50%. Moderately shrub- and herb-rich. Soils moist, imperfectly to poorly drained, silty to clayey textured. Developed primarily on lacustrine parent materials. Ground cover consists of broadleaf litter, conifer litter and wood.



Soil Types
S9, SS8, S10

Mode of Deposition
lacustrine, glaciofluvial

Humus Form
fibrimor, humifibrimor

Overstorey
trembling aspen, balsam fir, white spruce, white birch, balsam poplar, black spruce

Shrubs/Trees (<10 m)
Rubus pubescens, Sorbus decora, balsam fir, *Acer spicatum, Corylus cornuta, Alnus incana, Rosa acicularis, Actaea rubra, Viburnum edule, Rubus idaeus, Ribes triste*

Herbs and Graminoids
Aralia nudicaulis, Mertensia paniculata, Streptopus roseus, Clintonia borealis, Trientalis borealis, Mitella nuda, Maianthemum canadense, Cornus canadensis, Cinna latifolia, Dryopteris carthusiana, Gymnocarpium dryopteris, Petasites frigidus, Equisetum sylvaticum, Galium triflorum

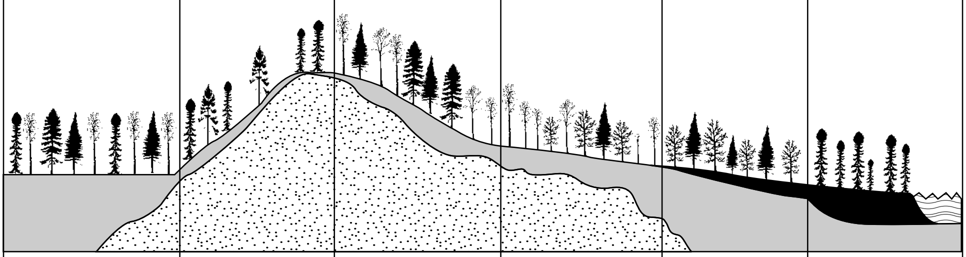
Mosses and Lichens
Pleurozium schreberi, Ptilium crista-castrensis

Comments

Ecosite features characteristic V-types V5, V6, V7, V8, V9 and occasionally V4, but expect to encounter V1 and V2 in isolated patches or in depressions. Topography is typically subdued and low. May be early successional stage of ES32.

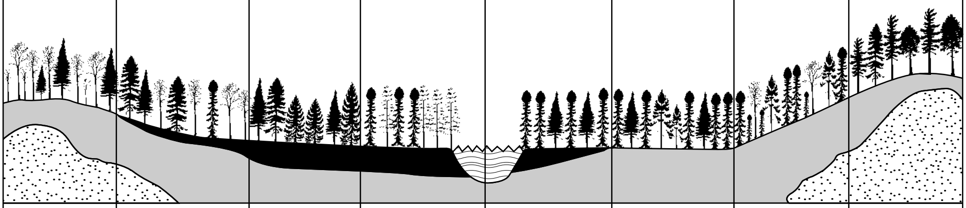
Typical Landscape Associations

Typical Ecosite Sequence on Very Shallow to Deep Silty to Clayey Glaciolacustrine Material



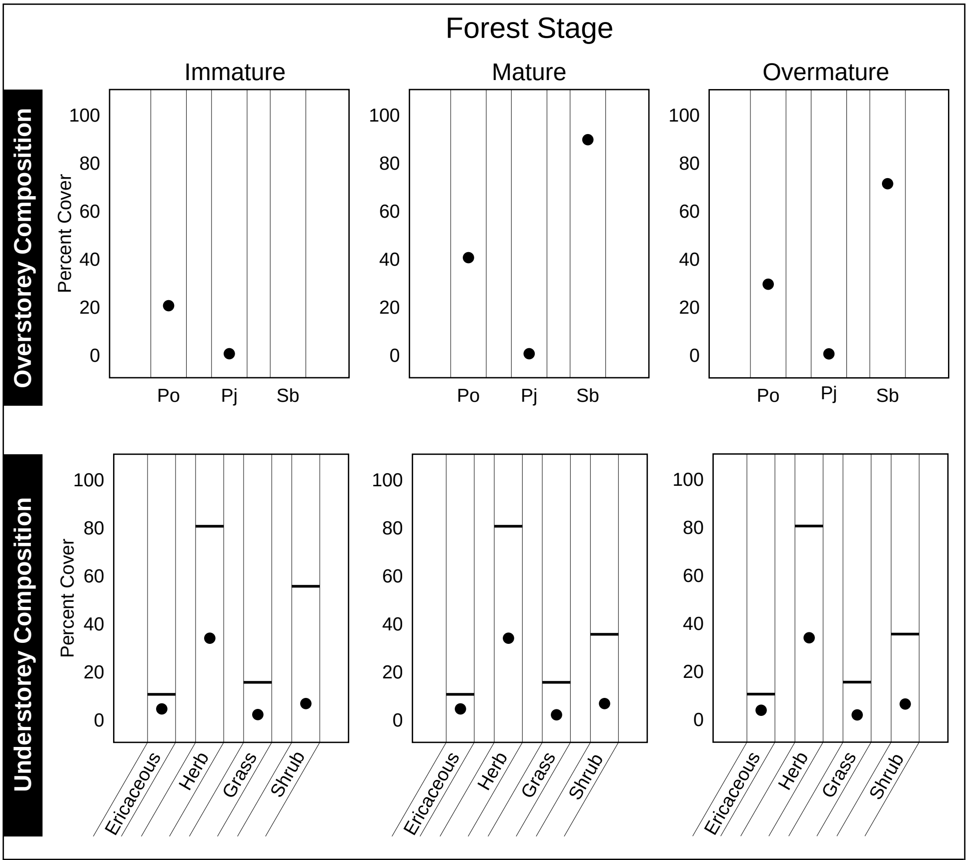
Po-Bf-Sw (Sb)	Sb-Pj	Po-Sw (Bf-Bw)	Ab-Po-Bw (Bf)	Ab (Bf)	Sb
ES33 Hardwood-Fir-Spruce Mixedwood: Moist, Silty-Clayey Soil	ES12 Black Spruce-Jack Pine: Very Shallow Soil	ES29 Hardwood-Fir-Spruce Mixedwood: Fresh, Fine Loamy-Clayey Soil	ES30 Black Ash Hardwood: Fresh, Silty-Clayey Soil	ES38 Rich Swamp: Black Ash (Other Hardwood): Organic-Mineral Soil	ES36 Intermediate Swamp: Black Spruce, (Tamarack): Organic Soil
V7 Trembling Aspen-Balsam Fir/ Balsam Fir Shrub	V30 Jack Pine-Black Spruce/ Blueberry/Lichen	V9 Trembling Aspen Mixedwood	V2 Black Ash Hardwood and Mixedwood	V2 Black Ash Hardwood and Mixedwood	V35 Black Spruce/ Speckled Alder/ Sphagnum
S10 Moist/Fine Loamy-Clayey	SS2 Extremely Shallow Soil on Bedrock	SS7 Shallow-Moderately Deep/ Silty-Fine Loamy-Clayey	S10 Moist/Fine Loamy-Clayey	S12F Wet/Organic (Feathermoss)	S12S Wet/Organic (Sphagnum)
Moist	Dry	Fresh	Moist	Wet	Wet

Typical Ecosite Sequence on Silty to Clayey Glaciolacustrine and Alluvial Material



Po (Bw-Bf)	Po-Sw-Bw (Sb-Bf)	Ce-Bf-Sw	Ta-Sb	Sb (Bf)	Sb (Bf-Pj)	Sb-Pj (Po-Bw)	Pw-Pr (Bw)
ES28 Hardwood-Fir-Spruce Mixedwood: Fresh, Silty Soil	ES33 Hardwood-Fir-Spruce Mixedwood: Moist, Silty-Clayey Soil	ES37 Rich Swamp: Cedar (Other Conifer): Organic Soil	ES36 Intermediate Swamp: Black Spruce (Tamarack): Organic Soil	ES31 Spruce-Pine/ Feathermoss: Moist, Silty-Clayey Soil	ES25 Pine-Spruce/ Feathermoss: Fresh, Silty Soil	ES26 Spruce-Pine/ Feathermoss: Fresh, Fine Loamy-Clayey Soil	ES24 Red Pine-White Pine: Fresh, Fine Loamy Soil
V5 Aspen Hardwood	V9 Trembling Aspen Mixedwood	V21 Cedar (inc. Mixedwood)/ Mountain Maple	V23 Tamarack (Black Spruce)/ Speckled Alder/ Labrador-tea	V34 Black Spruce/ Labrador-tea/ Feathermoss (Sphagnum)	V31 Black Spruce-Jack Pine/ Tall Shrub/ Feathermoss	V32 Jack Pine-Black Spruce/ Ericaceous Shrub/ Feathermoss	V26 White Pine Conifer
S4 Fresh/Silty-Silt Loamy	S9 Moist/Silty-Silt Loamy	S12F Wet/Organic (Feathermoss)	S12S Wet/Organic (Sphagnum)	S10 Moist/Fine Loamy-Clayey	S4 Fresh/Silty-Silt Loamy	S5 Fresh/Fine Loamy	SS7 Moist/Sandy
Fresh	Moist	Wet	Wet	Moist	Fresh	Fresh	Fresh

Site Structure and Composition



Advance Growth

Forest Stage

	Immature		Mature		Overmature	
	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)
Sb	0	N/A	4500	N/A	3750	N/A
Bf	0	N/A	158	N/A	3974	N/A

Seedbed

	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen
	0	6	94	0	0	0	6	94	0	0	0	6	94	0	0

Coarse Woody Debris

	Logs	Debris	Logs	Debris	Logs	Debris
	N/A	N/A	N/A	N/A	N/A	N/A

Vegetation and Soil Type Relationships

(number of plots with defined combinations)

5 Aspen Hardwood	6 Trembling Aspen (White Birch) – Balsam Fir / Mountain Maple	7 Trembling Aspen – Balsam Fir / Balsam Fir Shrub	8 Trembling Aspen (White Birch) / Mountain Maple	9 Trembling Aspen Mixedwood		
▨	▨	□	▨	□		
1	1	1	2	1		S9 – Moist / Silty – Silt Loamy
4	1	5	1	2		S10 – Moist / Fine Loamy – Clayey
1	1		2	2		SS8 – Shallow – Moderately Deep / Mottles – Gley
		1			▨	S11 – Moist / Peaty Phase

Description of Soil and Vegetation

▨ Characteristic Common

■ Common Inclusions

□ Characteristic Uncommon

Selected Species Habitat Use

Species	Forest Stage					Special Habitat Preferences
	Pre-Sapling	Sapling	Immature	Mature	Overmature	
Spruce Grouse						
Great Grey Owl				○	○	tamarack bogs preferred for nesting (use nests of other raptors)
Black-backed Woodpecker				○	○	snags
Pileated Woodpecker				○	●	snags, downed woody debris
Least Flycatcher				●	●	often found near open spaces (edge, riparian)
Boreal Chickadee				○	○	snags
Swainson's Thrush			●	●	●	
Nashville Warbler		○	○	○		high level of light penetration, preferably with shallow undergrowth
Connecticut Warbler						
White-throated Sparrow	○	○			○	numerous openings with low dense vegetation
Northern Flying Squirrel				○	○	snags
Southern Red-backed Vole		○	○	○	○	downed woody debris
Meadow Vole	○					fields, grassy meadows
Marten			○	●	●	snags, downed woody debris
Woodland Caribou (winter)						
Woodland Caribou (hab. rank)						
White-tailed Deer (forage)	●	●			○	
White-tailed Deer (cover)			○	●	●	
Moose (forage)	○	○				
Moose (cover)			○	○	○	

○ Used Habitat ● Preferred Habitat

Successional Relationships - Natural

No information available

Successional Relationships - Post-harvest

Response following harvest:

No information available

Response following harvest and mechanical site preparation:

No information available

Response following harvest and prescribed fire:

No information available

Site Productivity

Site Index by species and NWO FEC Soil Type
Site Index (breast height age 50 years)

Soil Type	Species		
	Sb	Pj	Po
S9	15.4	–	21.8
S10	10.0	–	22.8
SS8	15.3	–	17.2
S1	12.0	–	Non-productive

Black Spruce Advance Regeneration

	Vegetation Type		
	V5	V6	V7
Stocking (%)	N/A	N/A	N/A
Stocking Range	N/A	N/A	N/A
Stems per ha	N/A	N/A	N/A

V6 and V8 are the characteristic vegetation types with V7 as a common inclusion.

Trembling aspen, white birch, balsam fir and white spruce dominate the ecosite.

Hardwood vegetation types V5, V6 and V7 were not surveyed for advance growth. Due to the low density of black spruce in these V-types, the abundance of black spruce advance growth is assumed to be low.

The number and distribution of black spruce advance growth on this ecosite is positively related to:

- basal area of black spruce in the original stand

and inversely related to:

- percent cover of herbaceous species
- percent cover of broadleaf litter
- percent canopy closure

Natural Ingress Probability and Density (ten years post-disturbance)

No information available

Critical Comments

- Occasional large quantities of decadent trembling aspen may occur dependant upon aspen clonal properties and soil moisture regime.
- Heavy woody shrub and hardwood tree competition from mountain maple, speckled alder, beaked hazel, aspen and balsam fir should be expected. *Calamagrostis canadensis* and seedling balsam fir is often abundant following harvest when excessive amounts of soil are disturbed.
- Stands are vulnerable to spruce budworm if the proportion of balsam fir and white spruce in the stands exceeds 20 percent of the total crown volume.
- Soil/site conditions limit the use of hexazinone products for chemical site preparation.
- Natural regeneration of black spruce and jack pine limited by available local seed supply and lack of suitable supply and duration of receptive seedbed and smothering from hardwood leaf litter.
- Natural regeneration heavily dominated by balsam fir.
- Extensive slash resulting from, dead and dying balsam fir, residual balsam fir and balsam fir advance growth will limit the effectiveness of intermittent patch scarifiers and passive disc-trenchers.

Site Characteristics, Limitations and Hazard Potential

Characteristics							Limitations				Hazard Potential				
LFH Layer	Soil Texture	Depth to Bedrock	Stoniness	Moisture Regime	Terrain	Competition	Windthrow	Frost Heaving	Drought/Desiccation	Seasonal Flooding	Compaction	Rutting	Soil Erosion	Biomass & Nutrient Removal	Silvicultural Activities
1	1,2			3	2						3	3	1,2		Harvesting
1	1,2			3	2	1,4	5	1			3	3	1,2		Renewal
	1,2					1,4									Tending

Footnotes:

1. Disturbance of the forest floor on fine textured soils will promote non-crop vegetation and increase potential for erosion and frost heaving.
2. Soil erosion hazard increases with silt content. Hazard is moderate to high on slopes greater than ten percent.
3. Fine textured soils are susceptible to compaction and rutting when saturated during the frost free period.
4. High to very high competition. Mountain maple, beaked hazel, aspen, balsam fir and blue-joint grass are the principle competitors.
5. Potential for windthrow of shallow rooted species on moist, fine textured soils.

Opportunities

- This ecosite can also be managed to support forests dominated by balsam fir, white spruce, and/or white birch.
- Site quality for aspen growth and wood quality enhanced on this site, expecially where stone content approaches 30 percent and soils are calcareous.
- White spruce and black spruce seed trees, combined with site preparation for mineral soil exposure, can augment conifer regeneration levels.
- Use prescribed fire after harvest to eliminate dense balsam fir advance growth and create plantable spots or stimulate aspen suckering.
- Browse production potential is high, both before and after harvest.
- This ecosite may provide winter shelter for moose depending upon the habitat mosaic.
- Stands associated with this ecosite have a high degree of structural diversity contributing to their importance as potential habitat for small mammals, furbearers and a large number of songbirds.

Silvicultural Intensity Considerations

Species Objective	Site Productivity	Degree of Effort to Reach Free-to-grow
Black spruce	1 – 2	3
Jack pine	1 – 2	3
Aspen	1	1

Degree of Effort

1 = Extensive
2 = Basic
3 = Intensive
4 = Highly Intensive

Site Productivity - Site Productivity class (prime land productivity class) based upon height of dominant trees at age 50 years (breast height).

Silvicultural Interpretations for the Establishment of Black Spruce

Silvicultural System **• Harvest Method**	**Comments**	
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	R	Residual stand will not contribute seed of sufficient quantity. However, this cutting technique may be prescribed to meet other management objectives.
- Patch	R	See Strip/Block comment.
- Seed-tree	NR	Potential for natural seeding is very low due to infrequent occurrence of black spruce in the original stand, lack of receptive seedbed and potential for competition.
Shelterwood	NR	Black spruce is mid-tolerant and susceptible to windthrow after thinning of closed canopy stands.
Selection	NR	See Shelterwood comment.
Logging Method		Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season. Harvest on frozen ground or use low-impact equipment when soils are saturated.
Full-tree	CR	See Logging Method comment.
Tree-length	CR	See Logging Method comment.
Cut-to-length/Shortwood	CR	See Logging Method comment.
Renewal Treatments		
Site Preparation		High to very high competition on this site.
• Mechanical	CR	Techniques, timing and sequencing of treatments should be carefully considered. Minimize mineral soil exposure on clays to reduce the incidence of soil baking and/or frost heaving, and to prevent increased competition from non-crop vegetation on a mixed mineral/organic microsite. Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season. Chemi-mechanical site preparation should be considered. Potential for standing dead and down woody debris resulting from repeat spruce budworm infestation is high and will affect equipment operability and effectiveness.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Black Spruce (con't)

Renewal Treatments	Comments	
• Chemical	R	Some herbicide-resistant non-crop species may occur on this site.
• Prescribed Burn	R	Severity of burn will affect vegetation response. Fire will be beneficial for reduction of balsam fir competition, standing dead and down woody debris and associated heavy slash loads.
Regeneration • Natural - Advance Growth	NR	Black spruce advance growth is not of sufficient quantity or distribution to regenerate the site.
- Seed	NR	Potential for natural seeding is very low due to infrequent occurrence of black spruce in the original stand.
- Vegetative (coppice)	NR	Black spruce does not coppice.
• Artificial - Planting	R	Plant close to the mineral/organic interface.
- Seeding	NR	Reduced seeding success on clay soils. Smothering of seedbeds with hardwood litter will further limit success. The distribution, abundance and vigour of non-crop vegetation precludes the survival and growth of seed origin black spruce.
- Scarification	NR	Cone loading is low due to low density of black spruce in the original stand.
Tending Treatments		
Cleaning		High to very high competition on this site.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing is usually not necessary since black spruce natural regeneration is minimal.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine

Silvicultural System • Harvest Method	Comments	
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	R	Residual stand will not contribute seed of sufficient quantity or genetic quality. However, this cutting technique may be prescribed to meet other management objectives.
- Patch	R	See Strip/Block comment.
- Seed-tree	NR	Potential for natural seeding is very low due to infrequent occurrence of jack pine in the original stand.
Shelterwood	NR	Jack pine is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season. Harvest on frozen ground or use low-impact equipment when soils are saturated.
Full-tree	CR	See Logging Method comment.
Tree-length	CR	See Logging Method comment. Slash remaining on the site may reduce the effectiveness of mechanical site preparation and seedbed/plantable spot availability.
Cut-to-length/Shortwood	CR	See Tree-length comment.
Renewal Treatments		
Site Preparation		High to very high competition on this site.
• Mechanical	CR	Techniques, timing and sequencing of treatments should be carefully considered. Minimize mineral soil exposure on clays to reduce the incidence of soil baking and/or frost heaving, and to prevent increased competition from non-crop vegetation on a mixed mineral/organic microsite. Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season. Chemi-mechanical site preparation should be considered. Potential for standing dead and down woody debris resulting from repeat spruce budworm infestation is high and will affect equipment operability and effectiveness.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Jack Pine (con't)

Renewal Treatments	Comments	
• Chemical	R	Some herbicide-resistant non-crop species may occur on this site.
• Prescribed Burn	R	Severity of burn will affect vegetation response. Fire will be beneficial for reduction of balsam fir competition, standing dead and down woody debris and associated heavy slash loads.
Regeneration • Natural - Advance Growth	NR	Jack pine does not regenerate under a closed canopy.
- Seed	NR	Potential for natural seeding is very low due to infrequent occurrence of jack pine in the original stand.
- Vegetative (coppice)	NR	Jack pine does not coppice.
• Artificial - Planting	R	Plant close to the mineral/organic interface.
- Seeding	NR	Smothering of seedbeds with hardwood litter will limit success. In addition, the distribution, abundance and vigour of non-crop vegetation precludes the survival and growth of seed origin jack pine.
- Scarification	NR	Cone loading is low due to low density of jack pine in the original stand. Cone scattering will give variable results.
Tending Treatments		
Cleaning		High to very high competition on this site.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Spacing is usually not necessary since jack pine natural regeneration is minimal.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Aspen

Silvicultural System • Harvest Method		Comments
Clearcut • Harvest Method - Conventional	R	
- Strip/Block	CR	Strips should be at least 20 m wide to warm the soil and stimulate suckering. Strip cutting can also be prescribed to meet other management objectives.
- Patch	CR	Openings 0.4 ha in size are the minimum acceptable to stimulate aspen suckering. Patch cutting can also be prescribed to meet other management objectives.
- Seed-tree	NR	Leaving live aspen will reduce suckering.
Shelterwood	NR	Aspen is shade intolerant and generally not suited to this silvicultural system.
Selection	NR	See Shelterwood comment.
Logging Method		
Full-tree	CR	Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season. Harvest on frozen ground or use low-impact equipment when soils are saturated.
Tree-length	CR	See Logging Method comment. Slash remaining on the site will reduce soil temperature and sucker production.
Cut-to-length/Shortwsood	CR	See Tree-length comment. Concentration of slash in rows by single grip harvesters will create an uneven distribution of aspen suckers.
Renewal Treatments		
Site Preparation • Mechanical	NR	See Scarification (Section II, Book I).
• Chemical	R	Chemical site preparation may be used on sites where the residual overstorey will negatively affect root suckering. 2,4-D is recommended since it will remove the overstorey without damaging the aspen root systems.
• Prescribed Burn	R	

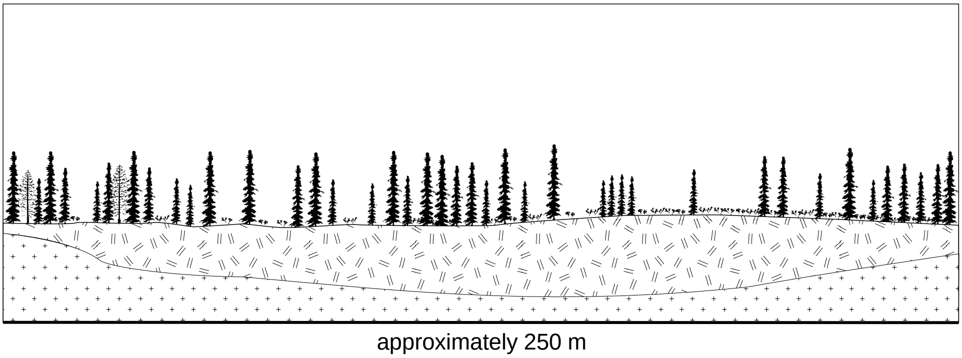
R = Recommended CR = Conditionally Recommended NR = Not Recommended

Silvicultural Interpretations for the Establishment of Aspen (con't)

Renewal Treatments	Comments	
Regeneration • Natural - Advance Growth	NR	Aspen does not regenerate under a closed canopy.
- Seed	NR	Aspen regeneration from seed is highly variable.
- Vegetative (coppice)	R	
• Artificial - Planting	NR	Insufficient data and/or field experience exist to recommend this technique. Planting of aspen seedlings may be considered when existing aspen has deteriorated to a point where vegetative regeneration is unlikely or undesirable.
- Seeding	NR	Insufficient data and/or field experience exist to recommend this technique.
- Scarification	CR	Techniques, timing and sequencing of treatments should be carefully considered. Fine textured soils are susceptible to rutting and compaction when saturated during the frost free season. Use low-impact equipment when soils are saturated. Potential for standing dead and down woody debris resulting from repeat spruce budworm infestation is high and will affect equipment operability and effectiveness.
Tending Treatments		
Cleaning		High to very high competition on this site. High initial densities and rapid early growth of aspen suckers will ensure their successful renewal.
• Manual	NR	
• Mechanical	NR	
• Chemical - Ground	NR	
- Aerial	NR	
Spacing	R	Site quality and timing is critical for the success of this treatment.

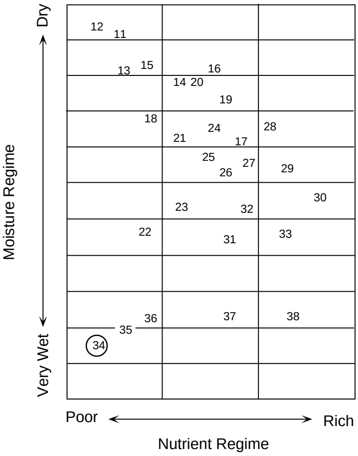
R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

ES 34 Treed Bog: Black Spruce / *Sphagnum:* Organic Soil



General Description

Treed wetlands with black spruce dominating the overstory. Tree size and cover variable. Understory dominated by ericaceous shrubs or sedges. Substrate *Sphagnum* peat usually deeper than 40 cm, but may be shallower at margins of peatlands. Ground cover consists of *Sphagnum* carpet with patches of feathermoss and conifer litter beneath trees.



Soil Types
S12S, S12F

Mode of Deposition
organic

Humus Form
fibric peatymor, mesic peatymor

Trees (>2 m)
black spruce

Shrubs/Trees (<2 m)
black spruce, *Chamaedaphne calyculata, Ledum groenlandicum, Vaccinium oxycoccos, Kalmia polifolia, Andromeda polifolia, Gaultheria hispidula*

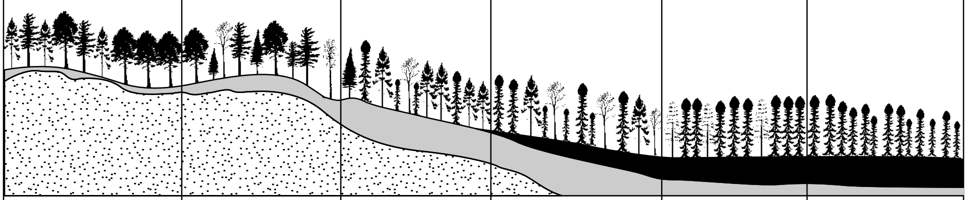
Herbs and Graminoids
Eriophorum vaginatum, Maianthemum trifolium, Sarracenia purpurea, Carex pauciflora, Carex oligosperma

Mosses and Lichens
Sphagnum magellanicum, Sphagnum fuscum, Pleurozium schreberi

Comments Characteristic V-types and W-types include V37, V38, W25 and W26. Minerotrophic indicators (especially *Betula pumila, Carex stricta or Carex aquatilis)* are occasionally present at low cover when rooted in minerotrophic peat beneath the bog. High hummocky microtopography with weakly developed hollows. Soils may grade to moderately deep peaty conditions (SS9). Rainwater nourished (ombrotrophic) and therefore very nutrient-poor, unlike poor swamps (ES35) and treed fens (ES40) which have contact with minerotrophic groundwater. Some poor swamps may key here if tree cover is high and minerotrophic indicators are restricted by low light levels. Crests of raised bog islands within large peatland complexes; also basin bogs, shores and adjacent to poor swamps.

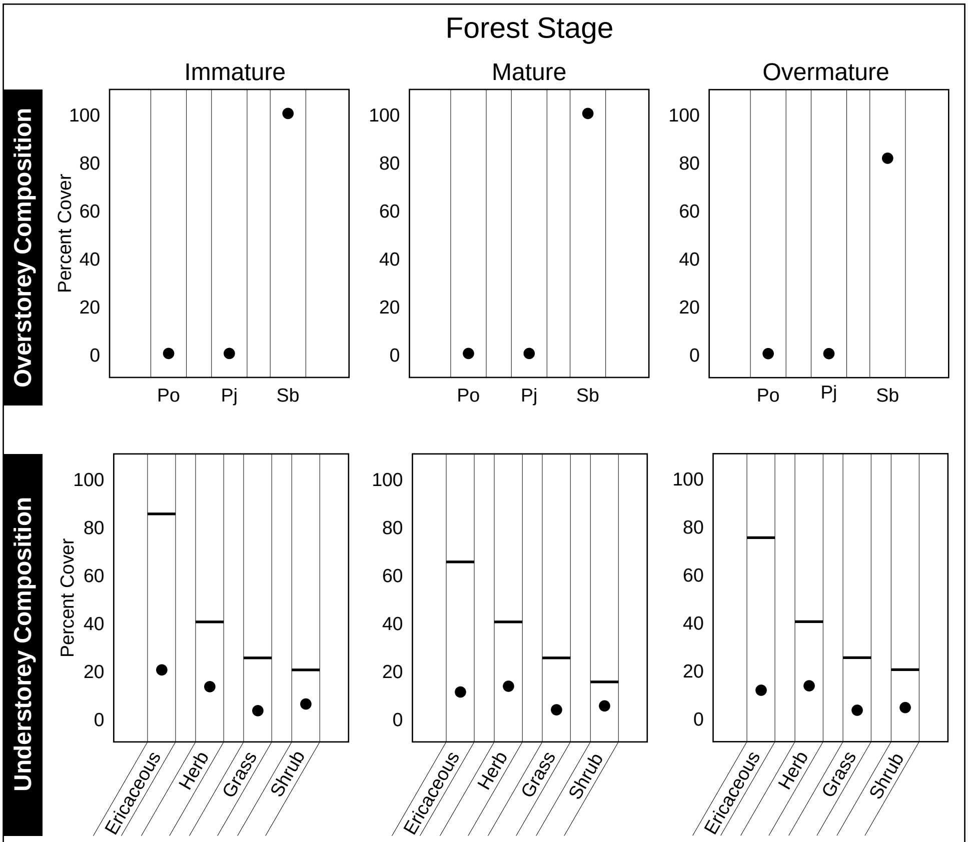
Typical Landscape Associations

Typical Ecosite Sequence on Very Shallow to Deep Coarse Loamy Till Material



Pr-Pw (Pj)	Pw-Pr-Bw (Po)	Pj-Sb (Bf-Bw)	Sb-Bw (Pj)	Sb (Ta)	Sb
ES11 Red Pine-White Pine-Jack Pine: Very Shallow Soil	ES18 Red Pine-White PIne: Fresh, Coarse Loamy Soil	ES20 Spruce-Pine/ Feathermoss: Fresh, Sandy-Coarse Loamy Soil	ES22 Spruce-Pine/ Ledum/ Feathermoss: Moist, Sandy-Coarse Loamy Soil	ES35 Poor Swamp: Black Spruce: Organic Soil	ES34 Treed Bog: Black Spruce/ Sphagnum: Organic Soil
V12 White PIne Mixedwood	V13 Red PIne Mixedwood	V18 Jack Pine Mixedwood/ Feathermoss	V20 Black Spruce Mixedwood/ Feathermoss	V34 Black Spruce/ Labrador-tea/ Feathermoss (Sphagnum)	V38 Black Spruce/ Leatherleaf/ Sphagnum
SS3 Very Shallow Soil On Bedrock	SS6 Shallow-Moderately Deep/ Coarse Loamy	S3 Fresh/ Coarse Loamy	S8 Moist/ Coarse Loamy	S12F Wet/ Organic (Feathermoss)	S12S Wet/Organic (Sphagnum)
Dry	Dry-Fresh	Fresh	Moist	Wet	Wet

Site Structure and Composition



Advance Growth	Forest Stage					
	Immature		Mature		Overmature	
	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)
Sb	0	N/A	6416	N/A	3651	N/A
Bf	1453	N/A	3362	N/A	7951	N/A

Seedbed															
	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen
	48	32	0	19	1	48	32	0	19	1	48	32	0	19	1

Coarse Woody Debris						
	Logs	Debris	Logs	Debris	Logs	Debris
	N/A	N/A	N/A	N/A	N/A	N/A

Vegetation and Soil Type Relationships

(number of plots with defined combinations)

37 Black Spruce / Ericaceous Shrub / Sphagnum	38 Black Spruce / Leatherleaf / Sphagnum		
▒	▒		
36	18	▒	S12S –Wet / Organic [Sphagnum]
		■	S12F –Wet / Organic [Feathermoss]

Description of Soil and Vegetation

- ▒ Characteristic Common
- ■ Common Inclusions
- □ Characteristic Uncommon

Selected Species Habitat Use

Species	Forest Stage					Special Habitat Preferences
	Pre-sapling	Sapling	Immature	Mature	Overmature	
Spruce Grouse				○	○	
Great Grey Owl						
Black-backed Woodpecker						
Pileated Woodpecker						
Least Flycatcher						
Boreal Chickadee						
Swainson's Thrush						
Nashville Warbler		○	○	○		high level of light penetration, preferably with shallow undergrowth
Connecticut Warbler	○	○	○	○	○	nests in spruce bogs/tamarack fens with well developed understorey
White-throated Sparrow	○	○			○	numerous openings with low dense vegetation
Northern Flying Squirrel						
Southern Red-backed Vole						
Meadow Vole						
Marten						
Woodland Caribou (winter)	○	○	○	●	●	arboreal lichens
Woodland Caribou (hab. rank)	●	●	●	●	●	
White-tailed Deer (forage)						
White-tailed Deer (cover)						
Moose (forage)						
Moose (cover)						

○ Used Habitat ● Preferred Habitat

Successional Relationships - Natural

No information available

Successional Relationships - Post-harvest

Response following harvest:

No information available

Response following harvest and mechanical site preparation:

No information available

Response following harvest and prescribed fire:

No information available

Site Productivity

Site Index by species and NWO FEC Soil Type

Site Index (breast height age 50 years)

Soil Type	Species		
	Sb	Pj	Po
S12S	9.3	–	Non-productive
S12F	8.6	–	Non-productive

Black Spruce Advance Regeneration

	Vegetation Type	
	V37	V38
Stocking (%)	43	86
Stocking Range	5 – 85	66 – 100
Stems per ha	9900	4500

V38 is the characteristic vegetation type with V37 as a common inclusion.

Black spruce dominates the ecosite.

This ecosite has a high probability of sufficient number and distribution of black spruce advance growth to regenerate the stand.

The number and distribution of black spruce advance growth on this ecosite is positively related to:

- basal area of black spruce in the original stand
- percent cover of sphagnum moss or Labrador-tea

and inversely related to:

- percent cover of herbaceous species
- percent cover of broadleaf litter
- percent canopy closure

Natural Ingress Probability and Density (ten years post-disturbance)

No information available

Critical Comments

- Low levels of woody shrub competition from speckled alder should be expected. Grass, sedge and cattails are often abundant following harvest when excessive amounts of soil are disturbed.
- High potential for windthrow of shallow rooted species such as black spruce due to high water table.
- High potential for rutting and disturbance of surface water movement which may impact on site productivity.

Site Characteristics, Limitations and Hazard Potential

Characteristics							Limitations				Hazard Potential				
LFH Layer	Soil Texture	Depth to Bedrock	Stoniness	Moisture Regime	Terrain	Competition	Windthrow	Frost Heaving	Drought/Desiccation	Seasonal Flooding	Compaction	Rutting	Soil Erosion	Biomass & Nutrient Removal	Silvicultural Activities
	1			1			2					1			Harvesting
	1			1			2					1			Renewal
															Tending

Footnotes:

1. High risk of rutting on organic soils.
2. High water table and shallow rooting zone creates windthrow risk when using strip cutting or group seed tree silvicultural systems.

Opportunities

- Lower-cost regeneration options are successful on this site.
- Careful logging to protect black spruce advance growth, combined with post-harvest cone loading and abundant Sphagnum seedbed, generally results in excellent regeneration.
- Consider leaving larger advance growth stems (e.g. < 12 cm diameter) to provide annual seed rain for ingress. This can significantly increase regeneration levels, with little impact on merchantable volume.
- Harvesting during frozen ground conditions, or using high-flotation equipment, will minimize ground disturbance and preserve receptive seedbed.
- During the frost free season, managers may consider selectively harvesting the perimeter of the stand, ensuring machine traffic is limited to minimize or avoid ground disturbance. Areas can then be left to regenerate naturally, or returned to during frozen-ground conditions.
- These sites are suitable to extended crop rotations due to limited productivity and the characteristic uneven age and size structure of these stands.
- Potential summer thermo-regulation or calving sites for moose, particularly if nearby supply of browse.

Silvicultural Intensity Considerations

Species Objective	Site Productivity	Degree of Effort to Reach Free-to-grow
Black spruce	4	1 – 2
Jack pine	N/A	N/A
Aspen	N/A	N/A

Site Productivity - Site Productivity class (prime land productivity class) based upon height of dominant trees at age 50 years (breast height).

Degree of Effort

1 = Extensive
2 = Basic
3 = Intensive
4 = Highly Intensive

Silvicultural Interpretations for the Establishment of Black Spruce

Silvicultural System **• Harvest Method**		**Comments**
Clearcut		
• Harvest Method - Conventional	R	Opportunity for protection of advance growth.
- Strip	R	
- Patch	R	
- Seed-tree	CR	Group seed tree only. Seeding will be supplemented by advance growth.
Shelterwood	NR	Multiple harvesting operations would significantly increase the risk of damage to this sensitive ecosite. Black spruce is mid-tolerant and susceptible to windthrow after thinning.
Selection	NR	See Shelterwood comment.
Logging Method		Harvest on frozen ground because organic soils are susceptible to rutting. On fibric peatymor soils, low-impact equipment may allow summer harvest.
Full-tree	CR	See Logging Method comment.
Tree-length	CR	See Logging Method comment.
Cut-to-length/Shortwood	CR	See Logging Method comment.
Renewal Treatments		
Site Preparation		Very low competition on this site. Alder is the principle competitor.
• Mechanical	CR	Organic soils are susceptible to rutting. Apply treatment on frozen ground. Where levels of advance growth are low, shearblading may be used to create seedbed/plantable micro-sites and align slash.
• Chemical	R	Some herbicide-resistant non-crop species may occur on this site.
• Prescribed Burn	R	Where levels of advance growth are low, high severity burns can be used to create receptive seedbeds and control non-crop vegetation.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Black Spruce (con't)

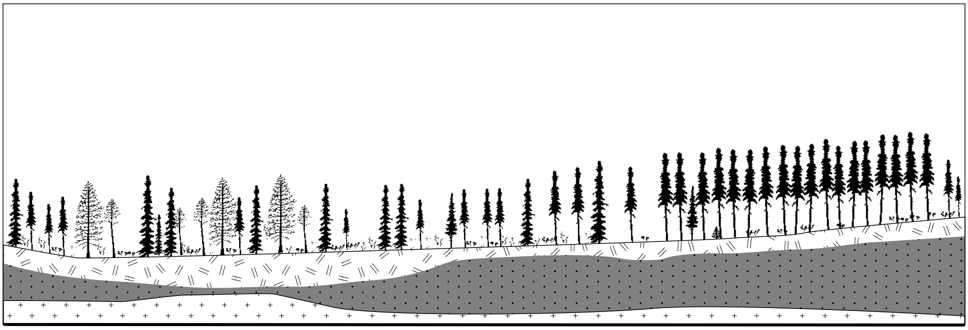
Renewal Treatments	**Comments**	
Regeneration • Natural - Advance Growth	R	High levels of advance growth. May require supplemental artificial regeneration.
- Seed	R	Insufficient data exist. Site conditions imply high levels of black spruce ingress. May require supplemental artificial regeneration.
- Vegetative (coppice)	NR	Black spruce does not coppice.
• Artificial - Planting	R	Where advance growth is insufficient to regenerate the site, black spruce can be planted in feathermoss, live sphagnum or partly decomposed sphagnum peat.
- Seeding	R	Site should be assessed for suitable seedbed and presence of advance growth. May require site preparation.
- Scarification	NR	Insufficient cone supply, potential seedbed degradation and lack of suitable microsites makes this technique ineffective.
Tending Treatments		
Cleaning		Very low competition on this site.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	The effectiveness of this treatment will be limited by low site productivity.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

The establishment of jack pine or aspen is not an appropriate management objective for this site.

Poor Swamp: Black Spruce: Organic Soil

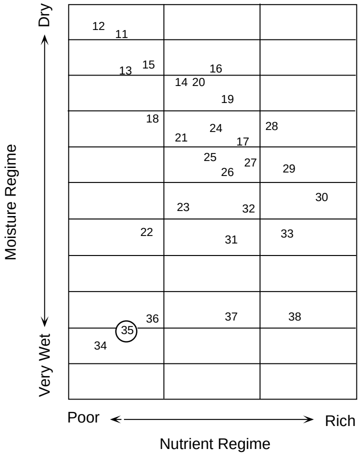
ES 35



approximately 250 m

General Description

Treed wetlands dominated by black spruce. Tree size and cover variable. Understory dominated by ericaceous shrubs, with some minerotrophic plant indicators. Rooting zone has some contact with minerotrophic groundwater but sites are relatively nutrient-poor. Substrate is fibric, woody or *Sphagnum* peat usually deeper than 40 cm, but may be shallower at margins of peatlands. Ground cover consists of feathermoss, *Sphagnum*, conifer litter and graminoid litter.



Soil Types
S12S, S12F, S11, SS9

Mode of Deposition
organic

Humus Form
fibric peatymor, mesic peatymor

Trees (>2 m)
black spruce

Shrubs/Trees (<2 m)
black spruce, *Ledum groenlandicum, Gaultheria hispidula, Vaccinium oxycoccos, Chamaedaphne calyculata, Vaccinium angustifolium, Vaccinium myrtilloides, Alnus incana, Kalmia polifolia*

Herbs and Graminoids
Maianthemum trifolium, Cornus canadensis, Equisetum sylvaticum, Carex trisperma, Calamagrostis canadensis

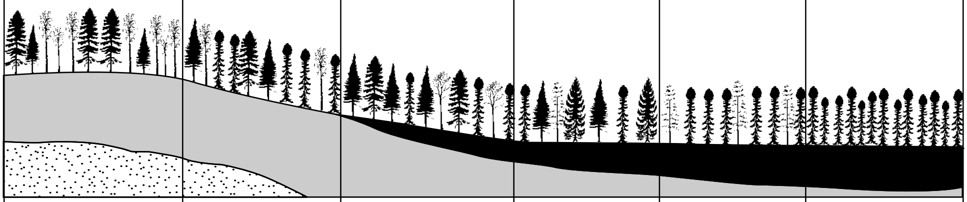
Mosses and Lichens
Pleurozium schreberi, Sphagnum capillifolium, Sphagnum magellanicum, Ptilium crista-castrensis, Dicranum polysetum, Sphagnum girgensohnii, Sphagnum angustifolium, Cladina rangiferina, Hylocomium splendens, Sphagnum fuscum

Comments

Characteristic V-types and W-types include V37, V38, W27 and W28. Trees often larger than those in ES34. Strongly hummocky microtopography with deep, often water-filled, hollows. Soils predominantly deep organic, but may locally grade to moderately deep peaty conditions (SS9). Rooting zone in contact with minerotrophic groundwater unlike treed bogs (ES34). Grades to intermediate swamp (ES36) with increasing nutrient availability and tree cover. Edges of open peatlands, poorly-drained depressions in bedrock or till.

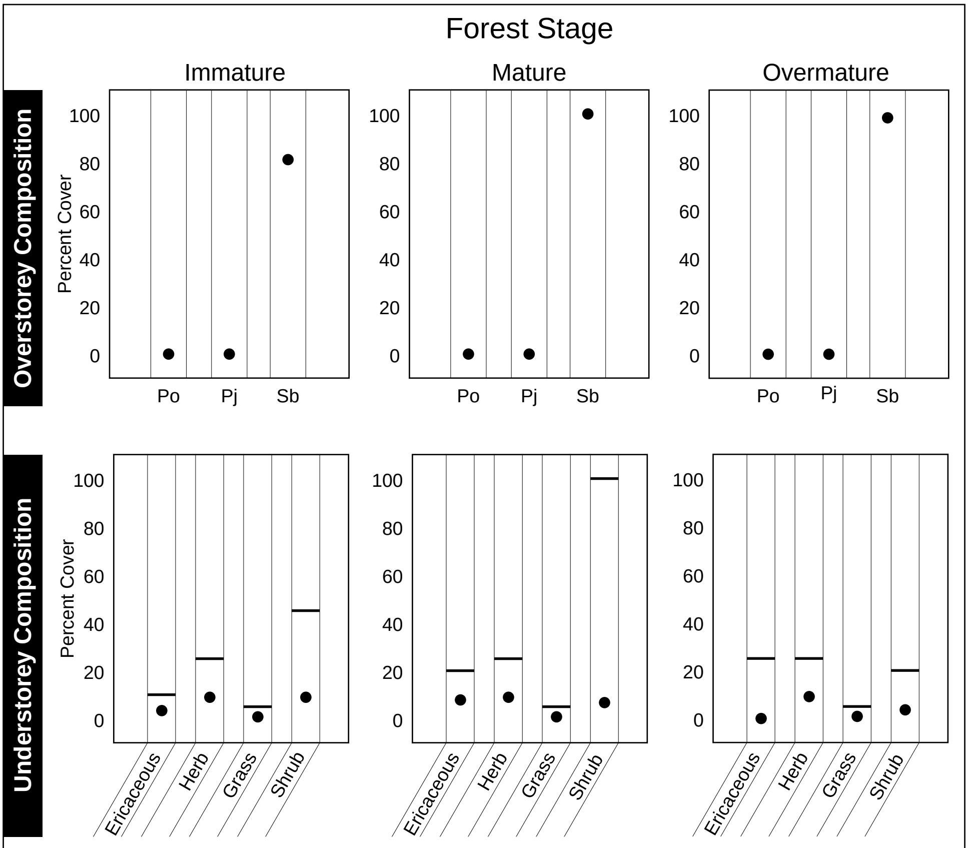
Typical Landscape Associations

Typical Ecosite Sequence on Deep Silty to Clayey Glaciolacustrine Material



Po-Sw (Bf)	Sb-Bf-Sw (Po)	Bf-Sw (Pb-Sb)	Ce-Bf (Sb-Ta)	Sb-Ta	Sb
ES29 Hardwood-Fir-Spruce Mixedwood: Fresh, Loamy-Clayey Soil	ES27 Fir-Spruce Mixedwood: Fresh, Silty-Fine Loamy Soil	ES32 Fir-Spruce Mixedwod: Moist, Silty-Clayey Soil	ES37 Rich Swamp: Cedar (Other Conifer): Organic Soil	ES36 Intermediate Swamp: Black Spruce (Tamarack): Organic Soil	ES35 Poor Swamp: Black Spruce: Organic Soil
V8 Trembling Aspen (White Birch)/ Mountain Maple	V16 Balsam Fir-White Spruce Mixedwood/ Feathermoss	V14 Balsam Fir Mixedwood	V22 Cedar (inc. Mixedwood)/ Speckled Alder/ Sphagnum	V23 Tamarack (Black Spruce)/ Speckled Alder/ Labrador-tea	V37 Black Spruce/ Ericaceous Shrub/ Sphagnum
S5 Fresh/Fine Loamy	S6 Fresh/Clayey	S10 Moist/Fine Loamy-Clayey	S12F Wet/Organic (Feathermoss)	S12S Wet/Organic (Sphagnum)	S12S Wet/Organic (Sphagnum)
Fresh	Fresh	Moist	Wet	Wet	Wet

Site Structure and Composition



Advance Growth

	Forest Stage					
	Immature		Mature		Overmature	
	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)
Sb	1739	N/A	1944	N/A	1806	N/A
Bf	6723	N/A	1859	N/A	7084	N/A

Seedbed

Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen
11	35	0	51	3	11	35	0	51	3	11	35	0	51	3

Coarse Woody Debris

Logs	Debris	Logs	Debris	Logs	Debris
N/A	N/A	N/A	N/A	N/A	N/A

Vegetation and Soil Type Relationships

(number of plots with defined combinations)

37 Black Spruce / Ericaceous Shrub / Sphagnum	38 Black Spruce / Leatherleaf / Sphagnum		
▨	□		
36	18	▨	S12S – Wet / Organic [Sphagnum]
		■	S12F – Wet / Organic [Feathermoss]
4		□	S11 – Moist / Peaty Phase
2		□	SS9 – Shallow – Moderately Deep / Organic – Peaty Phase

Description of Soil and Vegetation

▨ Characteristic Common

■ Common Inclusions

□ Characteristic Uncommon

Selected Species Habitat Use

Species	Forest Stage Pre-sapling	Sapling	Immature	Mature	Overmature	Special Habitat Preferences
Spruce Grouse			○	○	○	
Great Grey Owl				○	○	tamarack bogs preferred for nesting (use nests of other raptors)
Black-backed Woodpecker						
Pileated Woodpecker						
Least Flycatcher				●	●	often found near open spaces (edge, riparian)
Boreal Chickadee				○	○	snags
Swainson's Thrush			○	○	○	
Nashville Warbler		○	○	○		high level of light penetration, preferably with shallow undergrowth
Connecticut Warbler	○	○	●	●	●	nests in spruce bogs/tamarack fens with well developed understorey
White-throated Sparrow	○	○			○	numerous openings with low dense vegetation
Northern Flying Squirrel				○	○	snags
Southern Red-backed Vole	○	○	○	○	○	downed woody debris
Meadow Vole						
Marten			○	○	○	snags, downed woody debris
Woodland Caribou (winter)			○	○	●	arboreal lichens
Woodland Caribou (hab. rank)	●	●	●	●	●	
White-tailed Deer (forage)						
White-tailed Deer (cover)						
Moose (forage)						
Moose (cover)			●	●	●	

○ Used Habitat ● Preferred Habitat

Successional Relationships - Natural

No information available

Successional Relationships - Post-harvest

Response following harvest:

No information available

Response following harvest and mechanical site preparation:

No information available

Response following harvest and prescribed fire:

No information available

Site Productivity

Site Index by species and NWO FEC Soil Type

Site Index (breast height age 50 years)

Soil Type	Species		
	Sb	Pj	Po
S12S	9.3	Non-productive	–
S12F	8.6	Non-productive	–
S11	12.0	Non-productive	–
SS9	14.7	N/A	–

Black Spruce Advance Regeneration

	Vegetation Type	
	V37	V38
Stocking (%)	43	86
Stocking Range	5 – 85	66 – 100
Stems per ha	9900	4500

V37 is the characteristic vegetation type with V38 as a common inclusion.

Black spruce dominates the ecosite.

This ecosite has a high to moderate probability of sufficient number and distribution of black spruce advance growth to regenerate the site.

The number and distribution of black spruce advance growth on this ecosite is positively related to:

- basal area of black spruce in the original stand
- percent cover of sphagnum moss or Labrador-tea

and inversely related to:

- percent cover of herbaceous species
- percent cover of broadleaf litter
- percent canopy closure

Natural Ingress Probability and Density (ten years post-disturbance)

No information available

Critical Comments

- Low levels of woody shrub competition from speckled alder, labrador tea and leatherleaf should be expected. Grass, sedge and cattails are often abundant following harvest when excessive amounts of soil are disturbed.
- Prone to seasonal flooding.
- High potential for windthrow of shallow rooted species such as black spruce due to high water table.
- High potential for rutting and disturbance of surface water movement which may impact on site productivity.

Site Characteristics, Limitations and Hazard Potential

Characteristics							Limitations				Hazard Potential				
LFH Layer	Soil Texture	Depth to Bedrock	Stoniness	Moisture Regime	Terrain	Competition	Windthrow	Frost Heaving	Drought/Desiccation	Seasonal Flooding	Compaction	Rutting	Soil Erosion	Biomass & Nutrient Removal	Silvicultural Activities
	1			1								1			Harvesting
	1			1			2					1			Renewal
															Tending

Footnotes:

1. High risk of rutting on organic soils.
2. High water table and shallow rooting zone creates windthrow risk when using strip cutting or group seed tree silvicultural systems.

Opportunities

- On phases of this ecosite with abundant Sphagnum cover and advance growth, careful logging generally results in excellent regeneration.
- On phases of this ecosite with abundant Sphagnum cover and low advance growth levels, aerial seeding black spruce in the spring is an option
- Consider leaving larger advance growth stems (e.g. < 12 cm diameter), to provide annual seed rain for ingress. This can significantly increase regeneration levels, with little impact on merchantable volume. Small clumps of mature trees (group seed trees) are also effective.
- Area-based planting of black spruce container stock without site preparation is one option to augment regeneration levels following full-tree harvest operations.
- Minimizing ground disturbance will limit competition development (mainly grass, sedge and speckled alder) and lessen tending requirements.
- These sites are suitable for extended crop rotations due to limited productivity and the characteristic uneven age and size structure of these stands.

Silvicultural Intensity Considerations

Species Objective	Site Productivity	Degree of Effort to Reach Free-to-grow
Black spruce	4	1 – 2
Jack pine	N/A	N/A
Aspen	N/A	N/A

Site Productivity - Site Productivity class (prime land productivity class) based upon height of dominant trees at age 50 years (breast height).

Degree of Effort

1 = Extensive
2 = Basic
3 = Intensive
4 = Highly Intensive

Silvicultural Interpretations for the Establishment of Black Spruce

Silvicultural System **• Harvest Method**		**Comments**
Clearcut • Harvest Method - Conventional	R	Opportunity for protection of advance growth.
- Strip	R	
- Patch	R	
- Seed-tree	CR	Group seed tree. Seeding will be supplemented by advance growth.
Shelterwood	NR	Multiple harvesting operations would significantly increase the risk of damage to this sensitive ecosite. Black spruce is mid-tolerant and susceptible to windthrow after thinning of closed canopy stands.
Selection	NR	See Shelterwood comment.
Logging Method		Harvest on frozen ground because organic soils are susceptible to rutting. On fibric peatymor soils, low-impact equipment may allow summer harvest.
Full-tree	CR	See Logging Method comment.
Tree-length	CR	See Logging Method comment.
Cut-to-length/Shortwood	CR	See Logging Method comment.
Renewal Treatments		
Site Preparation		Very low competition on this site. Alder is the principle competitor.
• Mechanical	CR	Organic soils are susceptible to rutting. Apply treatment on frozen ground. Where low levels of advance growth exist, shearblading may be used to create seedbed/plantable micro-sites and align slash.
• Chemical	R	Some herbicide-resistant non-crop species may occur on this site.
• Prescribed Burn	R	Where levels of advance growth are low, high severity burns can be used to create a receptive seedbed and control competition.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

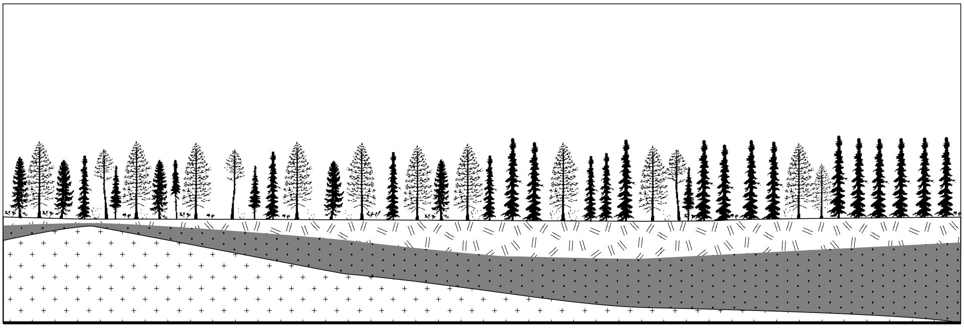
Silvicultural Interpretations for the Establishment of Black Spruce (con't)

Renewal Treatments	Comments	
Regeneration • Natural - Advance Growth	R	High levels of advance growth. May require supplemental artificial regeneration.
- Seed	R	Insufficient data exist. Site conditions imply high levels of black spruce ingress. May require supplemental artificial regeneration.
- Vegetative (coppice)	NR	Black spruce does not coppice.
• Artificial - Planting	R	Where advance growth is insufficient to regenerate the site, black spruce can be planted in feathermoss, live sphagnum or partly decomposed sphagnum peat.
- Seeding	R	Site should be assessed for suitable seedbed and presence of advance growth. May require site preparation.
- Scarification	NR	Insufficient cone supply, potential seedbed degradation and lack of suitable microsites makes this technique ineffective.
Tending Treatments		
Cleaning		Very low competition on this site.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	The effectiveness of this treatment will be limited by low site productivity.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

The establishment of jack pine or aspen is not an appropriate management objective for this site.

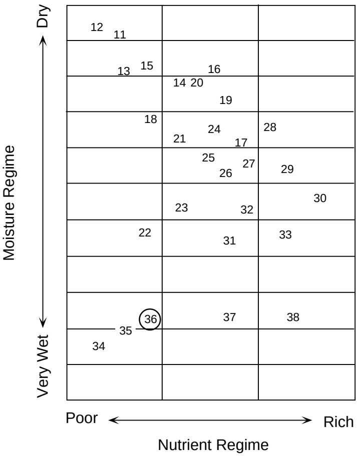
ES 36 Intermediate Swamp: Black Spruce (Tamarack): Organic Soil



approximately 250 m

General Description

Forested wetlands dominated by black spruce, often with tamarack, balsam fir or white cedar. Understory vegetation includes *Alnus incana* and other shrubs. Moderately shrub-, herb- and moss-rich. Soil is woody or *Sphagnum peat*. Ground cover consists of feathermoss, *Sphagnum,* conifer litter and broadleaf litter.



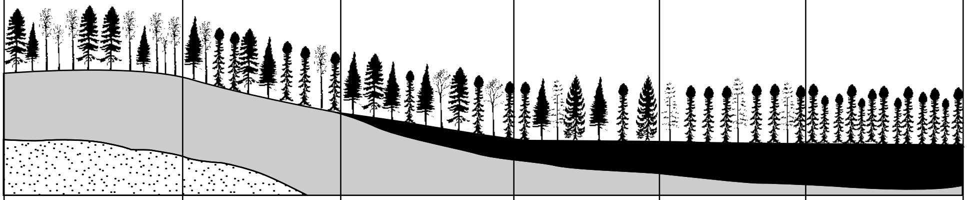
Soil Types
S12F, S12S, S11, SS9
Mode of Deposition
organic
Humus Form
fibric peatymor, mesic peatymor, humic peatymor
Trees (>2 m)
black spruce, tamarack
Shrubs/Trees (<2 m)
balsam fir, black spruce, *Gaultheria hispidula, Ledum groenlandicum, Linnaea borealis, Rubus pubescens, Alnus incana, Vaccinium myrtilloides, Vaccinium angustifolium, Sorbus decora*
Herbs and Graminoids
Cornus canadensis, Equisetum sylvaticum, Trientalis borealis, Coptis trifolia, Maianthemum trifolium, Maianthemum canadense, Clintonia borealis, Mitella nuda, Petasites frigidus, Carex disperma, Viola renifolia
Mosses and Lichens
Pleurozium schreberi, Ptilium crista-castrensis, Sphagnum girgensohnii, Sphagnum capillifolium, Hylocomium splendens, Dicranum polysetum, Sphagnum magellanicum, Sphagnum wulfianum

Comments

Characteristic V-types include V23, V35, V36, W29 and W30. Expect to encounter V34 near upland margins. Microtopography high hummocky with deep, often water-filled hollows. Higher nutrient availability and greater seepage than ES35. Topography typically flat to very gently sloping. Edges of open peatlands, shores of lakes and rivers above flooding level, and poorly-drained depressions in bedrock or till.

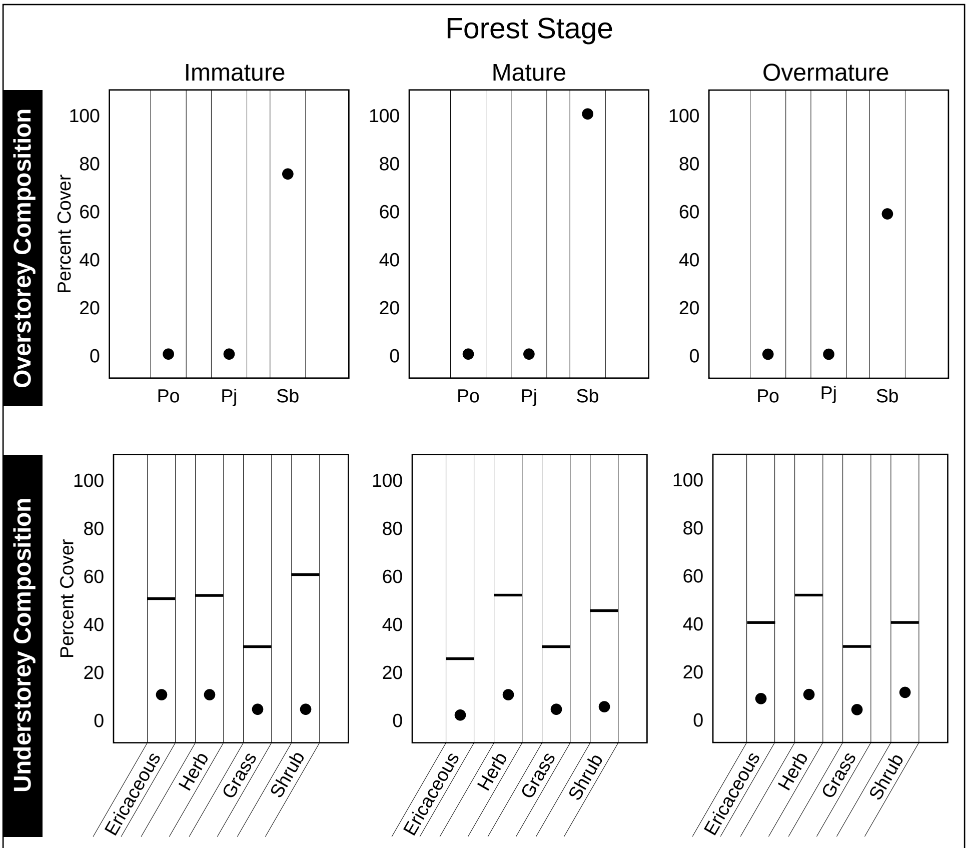
Typical Landscape Associations

Typical Ecosite Sequence on Deep Silty to Clayey Glaciolacustrine Material



Po-Sw (Bf)	Sb-Bf-Sw (Po)	Bf-Sw (Pb-Sb)	Ce-Bf (Sb-Ta)	Sb-Ta	Sb
ES29 Hardwood-Fir-Spruce Mixedwood: Fresh, Loamy-Clayey Soil	ES27 Fir-Spruce Mixedwood: Fresh, Silty-Fine Loamy Soil	ES32 Fir-Spruce Mixedwod: Moist, Silty-Clayey Soil	ES37 Rich Swamp: Cedar (Other Conifer): Organic Soil	ES36 Intermediate Swamp: Black Spruce (Tamarack): Organic Soil	ES35 Poor Swamp: Black Spruce: Organic Soil
V8 Trembling Aspen (White Birch)/ Mountain Maple	V16 Balsam Fir-White Spruce Mixedwood/ Feathermoss	V14 Balsam Fir Mixedwood	V22 Cedar (inc. Mixedwood)/ Speckled Alder/ Sphagnum	V23 Tamarack (Black Spruce)/ Speckled Alder/ Labrador-tea	V37 Black Spruce/ Ericaceous Shrub/ Sphagnum
S5 Fresh/Fine Loamy	S6 Fresh/Clayey	S10 Moist/Fine Loamy-Clayey	S12F Wet/Organic (Feathermoss)	S12S Wet/Organic (Sphagnum)	S12S Wet/Organic (Sphagnum)
Fresh	Fresh	Moist	Wet	Wet	Wet

Site Structure and Composition



Advance Growth	Forest Stage					
	Immature		Mature		Overmature	
	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)
Sb	1697	N/A	2250	N/A	2065	N/A
Bf	1039	N/A	5403	N/A	2023	N/A

Seedbed															
	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen
	17	24	0	48	1	17	24	0	48	1	17	24	0	48	1

Coarse Woody Debris						
	Logs	Debris	Logs	Debris	Logs	Debris
	N/A	N/A	N/A	N/A	N/A	N/A

Vegetation and Soil Type Relationships

(number of plots with defined combinations)

Tamarack (Black Spruce) / Speckled Alder / Labrador Tea 23	Black Spruce / Speckled Alder / Sphagnum 35	Black Spruce / Bunchberry / Sphagnum (Feathermoss) 36	Black Spruce / Ericcaceous Shrub / Sphagnum 37		
▒	▒	▒	■		
13	6	21		■	S12F – Wet / Organic [Feathermoss]
6	22	12	36	▒	S12S – Wet / Organic [Sphagnum]
1	2	2	4	□	S11 – Moist / Peaty Phase
1	1	1	2	□	SS9 – Shallow – Moderately Deep / Organic – Peaty Phase

Description of Soil and Vegetation

▒ Characteristic Common

■ Common Inclusions

□ Characteristic Uncommon

Selected Species Habitat Use

	Forest Stage					
Species	Pre-sapling	Sapling	Immature	Mature	Overmature	Special Habitat Preferences
Spruce Grouse			○	○	○	
Great Grey Owl				○	○	tamarack bogs preferred for nesting (use nests of other raptors)
Black-backed Woodpecker						
Pileated Woodpecker						
Least Flycatcher				●	●	often found near open spaces (edge, riparian)
Boreal Chickadee				○	○	snags
Swainson's Thrush			○	○	○	
Nashville Warbler		●	●	●		high level of light penetration, preferably with shallow undergrowth
Connecticut Warbler	○	○	●	●	●	nests in spruce bogs/tamarack fens with well developed understorey
White-throated Sparrow	○	○			○	numerous openings with low dense vegetation
Northern Flying Squirrel				○	○	snags
Southern Red-backed Vole		○	○	○	○	downed woody debris
Meadow Vole						
Marten			○	○	○	snags, downed woody debris
Woodland Caribou (winter)				○	○	arboreal lichens
Woodland Caribou (hab. rank)	○	○	●	●	●	
White-tailed Deer (forage)						
White-tailed Deer (cover)						
Moose (forage)						
Moose (cover)			●	●	●	

○ Used Habitat ● Preferred Habitat

Successional Relationships - Natural

No information available

Successional Relationships - Post-harvest

Response following harvest:

No information available

Response following harvest and mechanical site preparation:

No information available

Response following harvest and prescribed fire:

No information available

Site Productivity

Site Index by species and NWO FEC Soil Type

Site Index (breast height age 50 years)

Soil Type	Species		
	Sb	Pj	Po
S12F	8.6	Non-productive	–
S12S	9.3	Non-productive	–
S11	12.0	Non-productive	–
SS9	14.7	N/A	–

Black Spruce Advance Regeneration

	Vegetation Type		
	V23	V35	V36
Stocking (%)	18	34	38
Stocking Range	0 – 90	0 – 75	0 – 75
Stems per ha	900	2800	3100

V23 and V35 are the characteristic vegetation types with V36 as a common inclusion.

Black spruce and tamarack dominate the ecosite with occasional white cedar and balsam fir.

Where black spruce dominates the ecosite (V35), there is a moderate chance for sufficient density and distribution of black spruce advance growth to regenerate the site.

The number and distribution of black spruce advance growth on this ecosite is positively related to:

- basal area of black spruce in the original stand
- percent cover of sphagnum moss or Labrador-tea

and inversely related to:

- percent canopy closure

Natural Ingress Probability and Density (ten years post-disturbance)

Seedbed Condition	Species and Height Class					
	Sb		Pj		Po	
	< 1.0	> 1.0	< 1.0	> 1.0	< 1.0	> 1.0
Duff	X ■	H ▓	X ░	V ░	L ▒	H ▒
Mineral Soil	Insufficient Data					
Burned	Insufficient Data					

Probability Class

V- < 21%
L- 21 - 40%
M- 41 - 60%
H- 61 - 80%
X- > 80%

Density Class

░ < 300
▒ 300 - 1000
▓ 1001 - 5000
■ 5001 - 10000
█ > 10000

- Ingress of black spruce dominates this ecosite.
- Full ingress for all three major species is not achieved until nine or ten years after disturbance.

Critical Comments

- Low levels of woody shrub competition from speckled alder, labrador tea and leatherleaf should be expected. *Calamagrostis candensis*, sedge and cattails are often abundant following harvest when excessive amounts of soil are disturbed.
- Prone to seasonal flooding.
- High potential for windthrow of shallow rooted species such as black spruce due to high water table.
- High potential for rutting and compaction of organic layers. Disturbance of surface water movement may negatively impact site productivity.

Site Characteristics, Limitations and Hazard Potential

Characteristics							Limitations				Hazard Potential				
LFH Layer	Soil Texture	Depth to Bedrock	Stoniness	Moisture Regime	Terrain	Competition	Windthrow	Frost Heaving	Drought/Desiccation	Seasonal Flooding	Compaction	Rutting	Soil Erosion	Biomass & Nutrient Removal	Silvicultural Activities
	1			1			2			3	1	1			Harvesting
	1			1			2			3	1	1			Renewal
										3					Tending

Footnotes:

1. High risk of rutting and compaction on organic soils.
2. High water table and shallow rooting zone creates windthrow risk when using strip cutting or group seed tree silvicultural systems.
3. Seasonal flooding may limit access and equipment operability.

Opportunities

- On phases of this ecosite with abundant Sphagnum cover and advance growth, careful lgging can result in excellent regeneration.
- Aerial seeding black spruce can augment natural regeneration levels, but high competition (grass, sedge, alder, red raspberry) and limited Sphagnum levels constrain seeding chances.
- Consider leaving larger advance growth stems (e.g. < 12 cm diameter) to provide annual seed rain for ingress. This can significantly increase regeneration levels, with little impact on merchantable volume. Small clumps of mature trees (group seed trees) are also effective.
- Area-based planting of black spruce container stock following full-tree harvest operations may be the preferred option on the more productive sites close to the mill.
- Minimizing ground disturbance will limit competition development, although some tending is often required.
- These sites are suitable to extended crop rotations due to limited productivity and the characteristic uneven age and size structure of these stands.
- Moderate to high severity prescribed fire can reduce competition, while creating plantable spots or receptive seedbed.
- These sites could be managed for tamarack.

Silvicultural Intensity Considerations

Species Objective	Site Productivity	Degree of Effort to Reach Free-to-grow
Black spruce	4	1 – 2
Jack pine	N/A	N/A
Aspen	NA	N/A

Degree of Effort

1 = Extensive
2 = Basic
3 = Intensive
4 = Highly Intensive

Site Productivity - Site Productivity class (prime land productivity class) based upon height of dominant trees at age 50 years (breast height).

Silvicultural Interpretations for the Establishment of Black Spruce

Silvicultural System **• Harvest Method**	**Comments**	
Clearcut		Opportunity for protection of advance growth.
• Harvest Method - Conventional	R	
- Strip	R	
- Patch	R	
- Seed-tree	CR	Group seed tree. Seeding will be supplemented by advance growth.
Shelterwood	NR	Multiple harvesting operations would significantly increase the risk of damage to this sensitive ecosite. Black spruce is mid-tolerant and susceptible to windthrow after thinning of closed-canopy stands.
Selection	NR	See Shelterwood comment.
Logging Method		Harvest on frozen ground because organic soils are susceptible to rutting. On fibric peatymor soils, low-impact equipment may allow summer harvest.
Full-tree	CR	See Logging Method comment.
Tree-length	CR	See Logging Method comment.
Cut-to-length/Shortwood	CR	See Logging Method comment.
Renewal Treatments		
Site Preparation		Low to moderate competition on this site. Alder is the principle competitor.
• Mechanical	CR	Shearblading is not recommended when the water level is close to the surface.
• Chemical	R	Some herbicide-resistant non-crop species may occur on this site.
• Prescribed Burn	R	Where low levels of advance growth exist, high severity burns can be used to create receptive seedbed/plantable spots and control competition.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Black Spruce (con't)

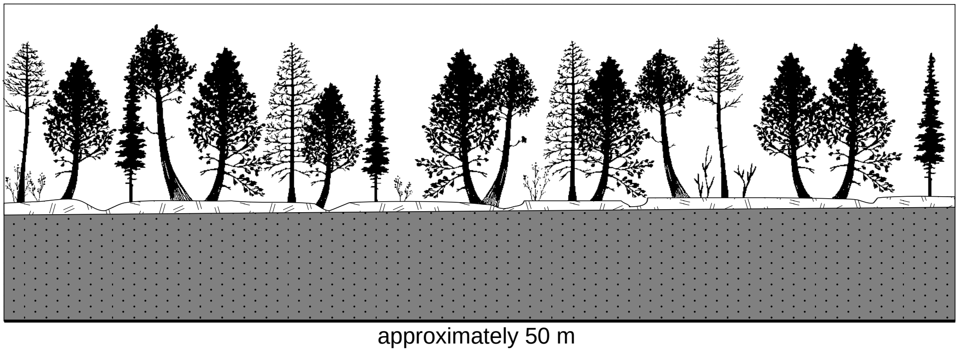
Renewal Treatments	Comments	
Regeneration		
• Natural		
- Advance Growth	R	Moderate levels of advance growth. May require supplemental artificial regeneration.
- Seed	R	Moderate levels of black spruce ingress. May require supplemental artificial regeneration.
- Vegetative (coppice)	NR	Black spruce does not coppice.
• Artificial		
- Planting	R	Where advance growth is insufficient to regenerate the site, black spruce can be planted in feathermoss, live sphagnum or partly decomposed sphagnum peat.
- Seeding	R	Site should be assessed for suitable seedbed and presence of advance growth.
- Scarification	NR	Insufficient cone supply, potential seedbed degradation and lack of suitable microsites makes this technique ineffective.
Tending Treatments		
Cleaning		Low to moderate competition on this site.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical		
- Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	The effectiveness of this treatment will be limited by low site productivity.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

The establishment of jack pine or aspen is not an appropriate management objective for this site.

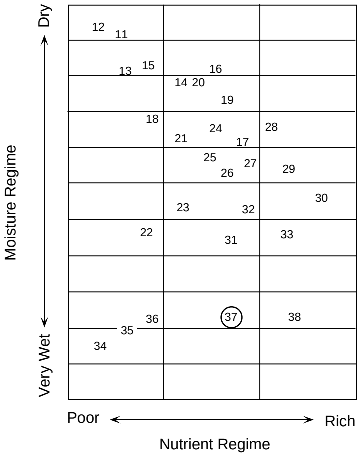
Rich Swamp: Cedar (Other Conifer): Organic Soil

ES 37



General Description

Forested wetlands with overstory dominated by white cedar and, less frequently, tamarack or black spruce. Balsam fir and white spruce may also be present. Understory is variable; *Acer spicatum and Alnus incana* are common, but generally with low cover. Herb-rich. Soils wet, organic or peaty phase. Ground cover consists of feathermoss, conifer litter, *Sphagnum* and wood.



Soil Types
S12F, S12S, S11, SS9

Mode of Deposition
organic

Humus Form
anmoor, fibric peatymor, mesic peatymor

Trees (>2 m)
white cedar

Shrubs/Trees (<2 m)
white cedar, balsam fir, *Rubus pubescens, Linnaea borealis, Cornus stolonifera, Acer spicatum, Alnus incana, Rosa acicularis, Gaultheria hispidula, Lonicera canadensis*

Herbs and Graminoids
Trientalis borealis, Cornus canadensis, Mitella nuda, Maianthemum canadense, Viola renifolia, Aralia nudicaulis, Coptis trifolia, Clintonia borealis, Streptopus roseus, Athyrium filix-femina, Gymnocarpium dryopteris, Aster macrophyllus

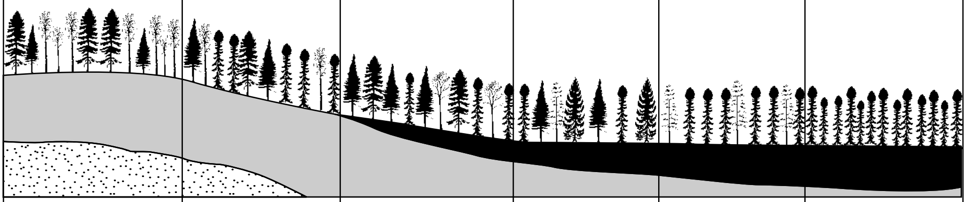
Mosses and Lichens
Pleurozium schreberi, Rhytidiadelphus triquetrus, Hylocomium splendens

Comments

Vegetation composed of various combinations of V2, V21, V22, V23, W31 and W32. Expect to encounter V35 and V34 along some margins. Tall spruce may overtop a subdominant cedar-tamarack layer. *Sphagnum* may be prominent. Fallen, moss-covered logs common. Microtopography high hummocky with deep, water-filled hollows. Topography is generally flat to very gently sloping. Shores of lakes and rivers, margins of flowage areas of peatland complexes, valleys with intermittent streams and groundwater movement.

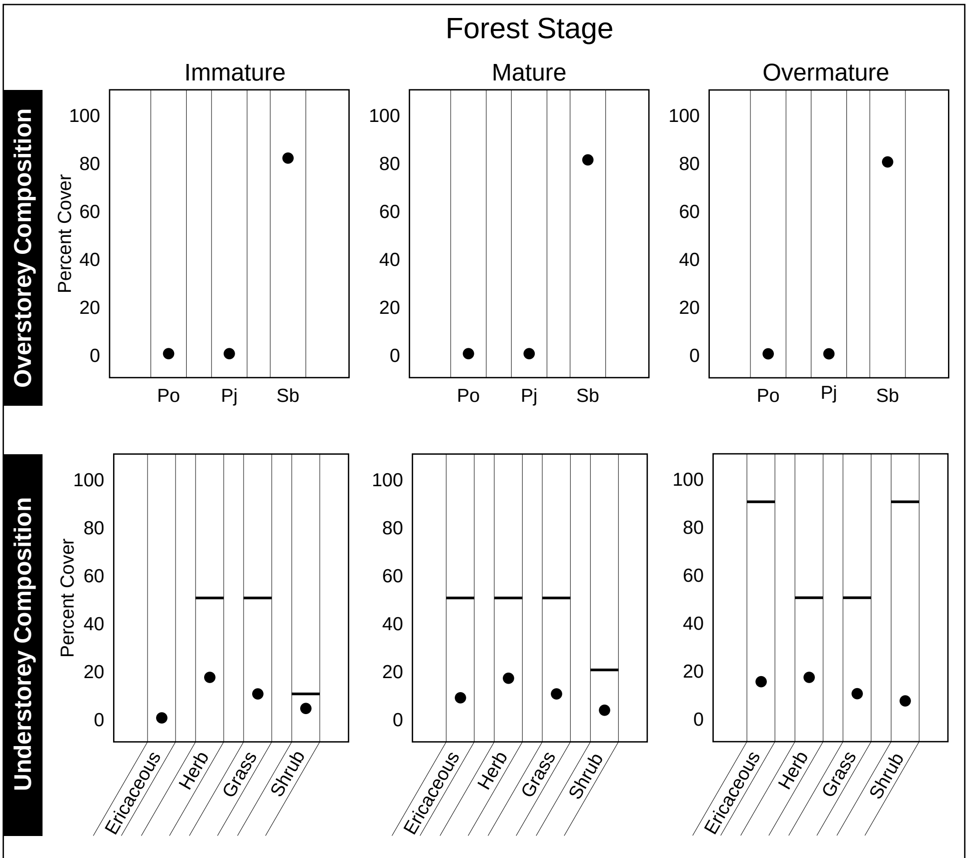
Typical Landscape Associations

Typical Ecosite Sequence on Deep Silty to Clayey Glaciolacustrine Material



Po-Sw (Bf)	Sb-Bf-Sw (Po)	Bf-Sw (Pb-Sb)	Ce-Bf (Sb-Ta)	Sb-Ta	Sb
ES29 Hardwood-Fir-Spruce Mixedwood: Fresh, Loamy-Clayey Soil	ES27 Fir-Spruce Mixedwood: Fresh, Silty-Fine Loamy Soil	ES32 Fir-Spruce Mixedwod: Moist, Silty-Clayey Soil	ES37 Rich Swamp: Cedar (Other Conifer): Organic Soil	ES36 Intermediate Swamp: Black Spruce (Tamarack): Organic Soil	ES35 Poor Swamp: Black Spruce: Organic Soil
V8 Trembling Aspen (White Birch)/ Mountain Maple	V16 Balsam Fir-White Spruce Mixedwood/ Feathermoss	V14 Balsam Fir Mixedwood	V22 Cedar (inc. Mixedwood)/ Speckled Alder/ Sphagnum	V23 Tamarack (Black Spruce)/ Speckled Alder/ Labrador-tea	V37 Black Spruce/ Ericaceous Shrub/ Sphagnum
S5 Fresh/Fine Loamy	S6 Fresh/Clayey	S10 Moist/Fine Loamy-Clayey	S12F Wet/Organic (Feathermoss)	S12S Wet/Organic (Sphagnum)	S12S Wet/Organic (Sphagnum)
Fresh	Fresh	Moist	Wet	Wet	Wet

Site Structure and Composition - Information Forthcoming



Advance Growth

Forest Stage

	Immature		Mature		Overmature	
	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)
Sb	0	n/a	697	n/a	224	n/a
Bf	0	n/a	2631	n/a	606	n/a

Seedbed

Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen
19	30	44	6	1	19	30	44	6	1	19	30	44	6	1

Coarse Woody Debris

Logs	Debris	Logs	Debris	Logs	Debris
n/a	n/a	n/a	n/a	n/a	n/a

Vegetation and Soil Type Relationships
(number of plots with defined combinations)

Black Ash Hardwood and Mixedwood	Cedar (inc. Mixedwood) / Mountain Maple	Cedar (inc. Mixedwood) / Speckled Alder / Sphagnum	Black Spruce / Speckled Alder / Sphagnum	Black Spruce / Labrador Tea / Feathermoss (Sphagnum)		
2	21	22	35	34		
■	▨	▨	■	■		
7	3	14	6	30		S12F – Wet / Organic [Feathermoss]
1		7	22	6		S12S – Wet / Organic [Sphagnum]
3		1	2	8	▨	S11 – Moist / Peaty Phase
2	1		1	3		SS9 – Shallow – Moderately Deep / Organic – Peaty Phase

Description of Soil and Vegetation
▨ Characteristic Common
■ Common Inclusions
□ Characteristic Uncommon

Selected Species Habitat Use

Species	Forest Stage					Special Habitat Preferences
	Pre-sapling	Sapling	Immature	Mature	Overmature	
Spruce Grouse				○	○	
Great Grey Owl						
Black-backed Woodpecker						
Pileated Woodpecker					○	snags, downed woody debris
Least Flycatcher				○	○	often found near open spaces (edge, riparian)
Boreal Chickadee				○	○	snags
Swainson's Thrush			○	○	○	
Nashville Warbler		○	○	○		high level of light penetration, preferably with shallow undergrowth
Connecticut Warbler	○	○	○	○	○	nests in spruce bogs/tamarack fens with well developed understorey
White-throated Sparrow	○	○			○	numerous openings with low dense vegetation
Northern Flying Squirrel				○	○	snags
Southern Red-backed Vole		○	○	●	●	downed woody debris
Meadow Vole						
Marten			○	○	○	snags, downed woody debris
Woodland Caribou (winter)						
Woodland Caribou (hab. rank)						
White-tailed Deer (forage)						
White-tailed Deer (cover)			○	●	●	
Moose (forage)	○	○				
Moose (cover)			●	●	●	

○ Used Habitat ● Preferred Habitat

Successional Relationships - Natural

No information available

Successional Relationships - Post-harvest

Response following harvest:

No information available

Response following harvest and mechanical site preparation:

No information available

Response following harvest and prescribed fire:

No information available

Site Productivity

Site Index by species and NWO FEC Soil Type

Site Index (breast height age 50 years)

Soil Type	Species		
	Sb	Pj	Po
S12F	8.6	Non-productive	–
S12S	9.3	Non-productive	–
S11	12.0	Non-productive	–
SS9	14.7	N/A	–

Black Spruce Advance Regeneration

	Vegetation Type	
	V21	V22
Stocking (%)	N/A	21
Stocking Range	N/A	0 – 60
Stems per ha	N/A	1600

V21 and V22 are the characteristic vegetation types.

Eastern white cedar dominates the ecosite with occasional tamarack and black spruce.

This ecosite has a low probability of sufficient density and distribution of black spruce advance growth to regenerate the site.

The number and distribution of black spruce advance growth on this ecosite is positively related to:

- basal area of black spruce in the original stand

and inversely related to:

- percent cover of herbaceous species

Natural Ingress Probability and Density (ten years post-disturbance)

No information available

Critical Comments

- Moderate woody shrub competition from speckled alder, mountain maple and red raspberry should be expected. *Calamagrostis candensis*, sedge and cattails are often abundant following harvest when excessive amounts of soil are disturbed.
- Prone to seasonal flooding.
- High potential for windthrow of shallow rooted species such as black spruce due to high water table.
- High potential for rutting and compaction of organic layers. Disturbance of surface water movement may negatively impact site productivity.

Site Characteristics, Limitations and Hazard Potential

Characteristics							Limitations				Hazard Potential				
LFH Layer	Soil Texture	Depth to Bedrock	Stoniness	Moisture Regime	Terrain	Competition	Windthrow	Frost Heaving	Drought/Desiccation	Seasonal Flooding	Compaction	Rutting	Soil Erosion	Biomass & Nutrient Removal	Silvicultural Activities
	1			1			2			4	1	1			Harvesting
	1			1		3	2			4	1	1			Renewal
						3				4					Tending

Footnotes:

1. High risk of rutting and compaction on organic soils.
2. High water table and shallow rooting zone creates windthrow risk when using strip cutting or group seed tree silvicultural systems.
3. High competition with raspberry, mountain maple and alder as the principle competitors.
4. Seasonal flooding may limit access and equipment operability.

Opportunities

- On phases of this ecosite with adequate advance growth, careful logging can preserve the black spruce and cedar component.
- Aerial seeding black spruce can augment natural regeneration levels, but high competition (grass, sedge, alder, red raspberry) and limited Sphagnum levels constrain seeding chances.
- Consider leaving larger advance growth stems (*e.g.* < 12 cm diameter) to provide annual seed rain for ingress. This can significantly increase regeneration levels, with little impact on merchantable volume. Small clumps of mature trees (group seed trees) are also effective.
- Area-based planting of black spruce container stock without site preparation is one option to augment regeneration levels following full-tree harvest operations.
- Minimizing ground disturbance will limit competition development, although some tending will be required.
- Moderate to high severity prescribed fire can reduce competition, while creating plantable spots or receptive seedbed.
- These sites can be managed for eastern white cedar when pre-harvest densities of the species is sufficient to meet minimum stocking standards.

Silvicultural Intensity Considerations

Species Objective	Site Productivity	Degree of Effort to Reach Free-to-grow
Black spruce	2	2 – 3
Jack pine	N/A	N/A
Aspen	N/A	N/A

Site Productivity - Site Productivity class (prime land productivity class) based upon height of dominant trees at age 50 years (breast height).

Degree of Effort

1 = Extensive
2 = Basic
3 = Intensive
4 = Highly Intensive

Silvicultural Interpretations for the Establishment of Black Spruce

Silvicultural System **• Harvest Method**		**Comments**
Clearcut • Harvest Method - Conventional	R	Opportunity for protection of advance growth.
- Strip	R	
- Patch	R	
- Seed-tree	CR	Group seed tree. Seeding will be supplemented by advance growth.
Shelterwood	NR	Multiple harvesting operations would significantly increase the risk of damage to this sensitive ecosite. Black spruce is mid-tolerant and susceptible to windthrow after thinning of closed canopy stands.
Selection	NR	See Shelterwood comment.
Logging Method		Harvest on frozen ground because organic soils are susceptible to rutting. On fibric peatymor soils, low-impact equipment may allow summer harvest.
Full-tree	CR	See Logging Method comment.
Tree-length	CR	See Logging Method comment.
Cut-to-Length/Shortwood	CR	See Logging Method comment.

R = Recommended   CR = Conditionally Recommended   NR = Not Recommended

Silvicultural Interpretations for the Establishment of Black Spruce (con't)

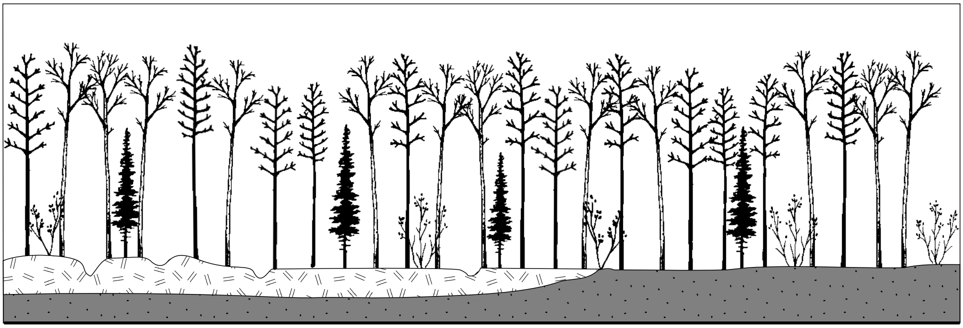
Renewal Treatments		Comments
Site Preparation		High competition on this site.
• Mechanical	CR	Shearblading is not recommended when the water level is close to the surface.
• Chemical	R	Some herbicide-resistant non-crop species may occur on this site.
• Prescribed Burn	R	High severity burns can be used to create plantable spots and control competition.
Regeneration • Natural - Advance Growth	NR	Black spruce advance growth is not of sufficient quantity and distribution to regenerate the site.
- Seed	R	High potential for natural seeding where black spruce dominates the stand.
- Vegetative (coppice)	NR	Black spruce does not coppice.
• Artificial - Planting	R	Where advance growth is insufficient to regenerate the site, black spruce can be planted in feathermoss, live sphagnum or partly decomposed sphagnum peat.
- Seeding	R	Site should be assessed for suitable seedbed prior to seeding.
- Scarification	NR	Insufficient cone supply, potential seedbed degradation and lack of suitable microsites makes this technique ineffective.
Tending Treatments		
Cleaning		High competition on this site.
• Manual	R	Cutting may stimulate stem sprouting and/or root suckering of non-crop species.
• Mechanical	R	See Manual Cleaning comment.
• Chemical - Ground	R	Some herbicide-resistant non-crop species may occur on this site.
- Aerial	R	See Chemical-Ground comment.
Spacing	R	Effectiveness of this treatment will be limited by low site productivity.

R = Recommended CR = Conditionally Recommended NR = Not Recommended

The establishment of jack pine or aspen is not an appropriate management objective for this site.

ES 38

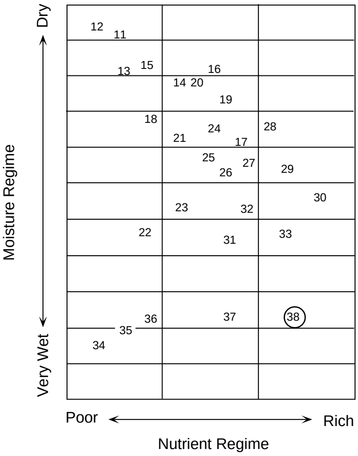
Rich Swamp: Black Ash (Other Hardwood): Organic–Mineral Soil



approximately 50 m

General Description

Forested wetland usually dominated by black ash and/or white elm. Often shrub-, herb- and graminoid-rich, but species composition variable. Seasonally flooded; water table at or near the surface for most of the growing season. May have small permanent pools, which are relatively low in cover. Soil well-decomposed woody peat or fine-textured mineral soil. Ground cover consists of deciduous litter, logs and patches of moss.



Soil Types

S11, S10

Mode of Deposition

alluvial, lacustrine

Humusform

mesic peatymor, humimor, anmoor

Trees (>2 m)

black ash, white elm

Shrubs/Trees (<2 m)

black ash, balsam fir, white spruce, *Rubus pubescens, Acer spicatum, Ribes triste, Cornus stolonifera, Rubus idaeus, Prunus virginiana, Corylus cornuta*

Herbs and Graminoids

Mitella nuda, Athyrium filix-femina, Caltha palustris, Circaea alpina, Dryopteris carthusiana, Aralia nudicaulis, Maianthemum canadense, Gymnocarpium dryopteris, Streptopus roseus, Trientalis borealis, Aster macrophyllus, Carex gracillima, Carex intumescens, Equisetum sylvaticum, Fragaria virginiana

Mosses and Lichens

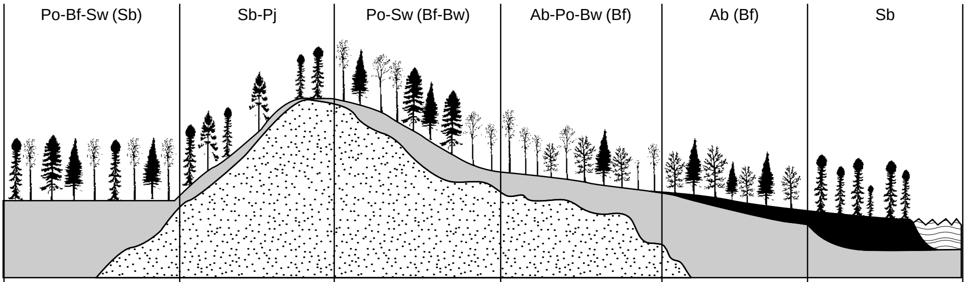
Plagiomnium cuspidatum, Climacium dendroides

Comments

Richest of forested wetland ecosites. Characteristic plant communities include V2, W33 and W34. Expect associations with V1 and ES36. May include tolerant hardwoods (e.g. green ash, yellow birch and red maple) in Site Regions 4S, 4W and 5S. Enriched by deposition of mineral and organic material during flooding associated with spring run-off or heavy rainfall. Microtopography flat to hummocky. Fallen, moss-covered logs common. Generally not found in large contiguous units. Often located in depressions, valleys with impeded drainage, or floodplains of rivers, streams, lakes and deltas. Grades to ES30.

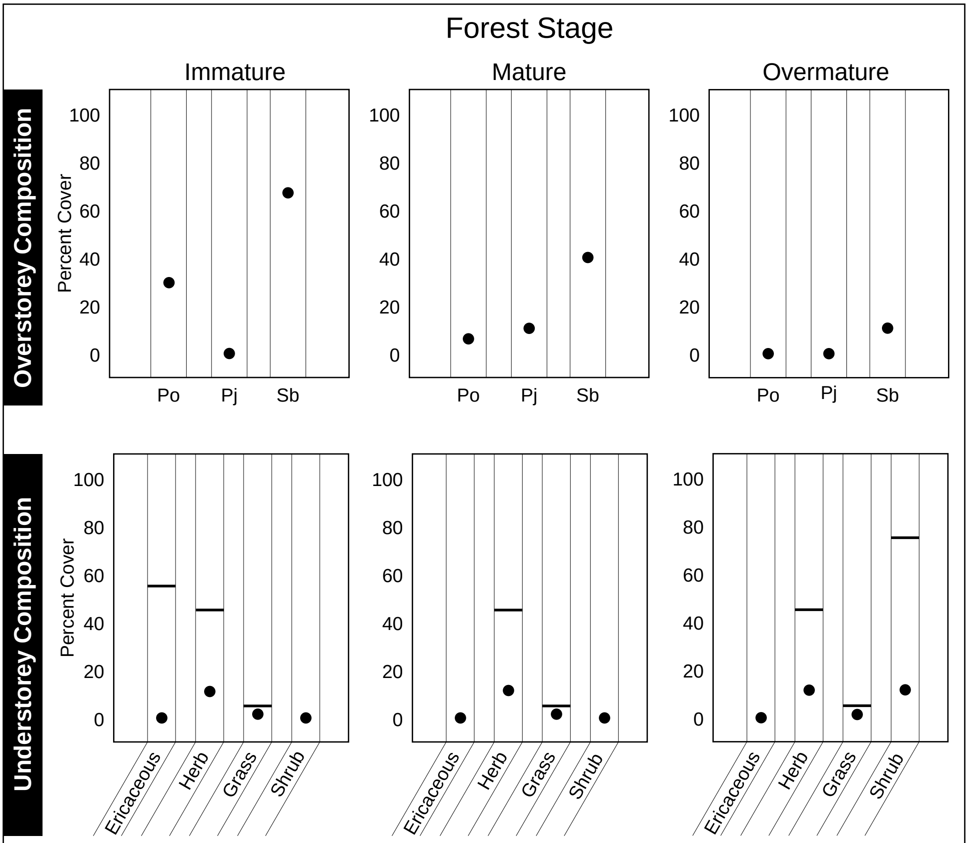
Typical Landscape Associations

Typical Ecosite Sequence on Very Shallow to Deep Silty to Clayey Glaciolacustrine Material



ES33 Hardwood-Fir-Spruce Mixedwood: Moist, Silty-Clayey Soil	ES12 Black Spruce-Jack Pine: Very Shallow Soil	ES29 Hardwood-Fir-Spruce Mixedwood: Fresh, Fine Loamy-Clayey Soil	ES30 Black Ash Hardwood: Fresh, Silty-Clayey Soil	ES38 Rich Swamp: Black Ash (Other Hardwood): Organic-Mineral Soil	ES36 Intermediate Swamp: Black Spruce, (Tamarack): Organic Soil
V7 Trembling Aspen-Balsam Fir/ Balsam Fir Shrub	V30 Jack Pine-Black Spruce/ Blueberry/Lichen	V9 Trembling Aspen Mixedwood	V2 Black Ash Hardwood and Mixedwood	V2 Black Ash Hardwood and Mixedwood	V35 Black Spruce/ Speckled Alder/ Sphagnum
S10 Moist/Fine Loamy-Clayey	SS2 Extremely Shallow Soil on Bedrock	SS7 Shallow-Moderately Deep/ Silty-Fine Loamy-Clayey	S10 Moist/Fine Loamy-Clayey	S12F Wet/Organic (Feathermoss)	S12S Wet/Organic (Sphagnum)
Moist	Dry	Fresh	Moist	Wet	Wet

Site Structure and Composition



Advance Growth	Forest Stage					
	Immature		Mature		Overmature	
	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)	Density (stems/ha)	Stocking (%)
Sb	N/A	N/A	N/A	N/A	N/A	N/A
Bf	N/A	N/A	N/A	N/A	N/A	N/A

Seedbed															
	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen	Sphag	Fthr	Bdlf	Con	Lichen
	0	39	0	54	7	0	39	54	0	7	0	39	0	54	7

Coarse Woody Debris						
	Logs	Debris	Logs	Debris	Logs	Debris
	N/A	N/A	N/A	N/A	N/A	N/A

Vegetation and Soil Type Relationships

(number of plots with defined combinations)

Black Ash Hardwood and Mixedwood	Balsam Poplar Hardwood and Mixedwood		
2	1		
▨	▨		
6	10	▨	S10 – Moist / Fine Loamy – Clayey
3	1	□	S11 – Moist / Peaty Phase

Description of Soil and Vegetation

▨	Characteristic Common
■	Common Inclusions
□	Characteristic Uncommon

Selected Species Habitat Use

Species	Forest Stage Pre-sapling	Sapling	Immature	Mature	Overmature	Special Habitat Preferences
Spruce Grouse						
Great Grey Owl						
Black-backed Woodpecker						
Pileated Woodpecker				○	●	snags, downed woody debris
Least Flycatcher				○	○	often found near open spaces (edge, riparian)
Boreal Chickadee						snags
Swainson's Thrush			○	○	○	
Nashville Warbler		○	○	○		high level of light penetration, preferably with shallow undergrowth
Connecticut Warbler						
White-throated Sparrow	○	○			○	numerous openings with low dense vegetation
Northern Flying Squirrel				○	○	snags
Southern Red-backed Vole		○	○	○	○	downed woody debris
Meadow Vole	○					fields, grassy meadows
Marten			○	○	○	snags, downed woody debris
Woodland Caribou (winter)						
Woodland Caribou (hab. rank)						
White-tailed Deer (forage)	○	○			○	
White-tailed Deer (cover)						
Moose (forage)	○	○				
Moose (cover)						

○ Used Habitat ● Preferred Habitat

Successional Relationships - Natural

No information available

Successional Relationships - Post-harvest

Response following harvest:

No information available

Response following harvest and mechanical site preparation:

No information available

Response following harvest and prescribed fire:

No information available

Site Productivity

Site Index by species and NWO FEC Soil Type

Site Index (breast height age 50 years)

Soil Type	Species		
	Sb	Pj	Po
S10	10.0	17.0	22.8
S11	12.0	Non-productive	–

Black Spruce Advance Regeneration

	Vegetation Type
	V2
Stocking (%)	N/A
Stocking Range	N/A
Stems per ha	N/A

V2 is the characteristic vegetation type.

This vegetation type was not surveyed for black spruce advance growth. Due to the low density of black spruce in this V-type, black spruce advance growth is assumed to be low.

Natural Ingress Probability and Density (ten years post-disturbance)

No information available

Critical Comments

- Moderate woody shrub competition from mountain maple, beaked hazel, high bush cranberry and red raspberry should be expected. *Calamagrostis candensis,* sedge and cattails are often abundant following harvest when excessive amounts of soil are disturbed.
- Prone to seasonal flooding and sustained high water table..
- High potential for rutting and compaction of organic layers. Disturbance of surface water movement may negatively impact site productivity.

Site Characteristics, Limitations and Hazard Potential

Characteristics						Limitations					Hazard Potential				
LFH Layer	Soil Texture	Depth to Bedrock	Stoniness	Moisture Regime	Terrain	Competition	Windthrow	Frost Heaving	Drought/Desiccation	Seasonal Flooding	Compaction	Rutting	Soil Erosion	Biomass & Nutrient Removal	Silvicultural Activities
1	1,2									5	2	2			Harvesting
1	1,2					1,4		3		5	2	2			Renewal
						1,4				5					Tending

Footnotes:

1. Disturbance of the forest floor on fine textured soils will promote non-crop vegetation.
2. High risk of rutting and compaction on organic soils.
3. Potential for frost heaving on this site.
4. High competition with raspberry, mountain maple and beaked hazel as the principle competitors.
5. Seasonal flooding may limit access and equipment operability.

Opportunities

- These sites should be maintained in the black ash or white elm working group.
- Selection harvest during frozen conditions will minimize ground disturbance, thereby avoiding site damage and limiting competition development.
- High value hardwood sawlog or veneer product potential. Growth potential high.

Silvicultural Intensity Considerations

Species Objective	Site Productivity	Degree of Effort to Reach Free-to-grow
Black spruce	3 – 4	1 – 2
Jack pine	4	3
Aspen	4	N/A

Site Productivity - Site Productivity class (prime land productivity class) based upon height of dominant trees at age 50 years (breast height).

Degree of Effort

1 = Extensive
2 = Basic
3 = Intensive
4 = Highly Intensive

The establishment of black spruce, jack pine or aspen is not an appropriate management objective for this ecosite.