

## H6 INTRODUCTION TO FORESTS

Forest trees grow in well defined associations. Reasons for this are not fully understood, although site characteristics, especially shade and soil moisture, are clearly very important. Species which thrive under similar conditions tend to occur together. Many individual trees, however, grow in other sites and with species other than their usual association. The recognition of forest-cover type groups is best re-

garded as generality, as a way of distinguishing the typical elements in order to understand it. Once these groupings are recognized, they can be used to understand the forest's evolution, its relationship to physical characteristics and to other elements of the flora and the fauna and its relationship to natural and human-induced disturbances.

H6  
Introduction  
to Forests



**Plate H6I.1:** Forest-dominated Nova Scotian landscape reflects the variety of treed habitats — hardwoods at the base of the slope on the intervalle, softwoods on the lower slope, mixed at the top. Photo: R. Merrick

## NATURAL FOREST STAND DEVELOPMENT

There are typically four stages in the natural development of a forest stand: initiation, stem exclusion, understory initiation and old growth. The nature of the development and eventually old-growth stage varies regionally.<sup>1</sup>

1. Stand initiation is the regeneration stage following a major disturbance, such as fire, windthrow or clearcutting. Tree species, accompanied by shrubs and herbaceous species, invade the disturbed site from an external seed source, existing seed banks, sprouts or suckers, and/or by advanced regeneration. This initial stage can continue for up to twenty years, depending on forest type, the type of disturbance, the regenerating strategies assumed by invading species and other factors.
2. Stem exclusion occurs once the disturbed site is fully occupied by young trees, and competition for environmental resources and growing space excludes new growth. Dieback as well as weeding of existing stressed individuals occurs.
3. Understorey initiation begins as the stand matures and gaps in the canopy allow light to penetrate and reach the ground. Generally, shade-tolerant species can then become established as an understory.
4. The old-growth stage begins as the regenerating species become codominant and the stand develops a multi-layer structure (with a canopy, saplings/shrubs and ground cover).

## OLD FORESTS

Old forests evolve from immature forests yet are significantly different in species composition and structure. In particular, as the forest ages, it becomes multi-layered, with large old trees, snags, and large amounts of coarse, woody debris accumulating on the ground. This change in structure creates many microhabitats both within the tree canopy and on the ground, resulting in an increase in general biodiversity.<sup>2</sup>

The Nova Scotia Forest Inventory, Provincial Summary 1977-89 (June 1991) shows that only 0.6 per cent of the province's forests are over 100 years of age, and 3.4 per cent are over eighty years old. The current age-class distribution reflects the long history of forestry in Nova Scotia and of natural disturbance.

Table H6I.1 illustrates the relative age of trees associated with old forests.

Climax refers to the end point of succession; the community reaches a steady state under a particular set of environmental conditions. Old-growth refers to the age of trees, but does not necessarily imply a climax stage.

## FOREST HABITATS AND ASSOCIATIONS

The classification of the forest habitats in the Natural History of Nova Scotia reflects the relative dominance of hardwoods (deciduous trees) and softwoods (coniferous trees). The descriptions of these habitats are further divided into tree-species associations that reflect combinations of the dominant forest-stand types in Nova Scotia. The information is based on analysis of the permanent sample plots maintained by the Nova Scotia Department of Natural Resources.

### **Hardwood-forest Habitat (H6.1)**

1. Red Maple, Red Oak, White Birch
2. Sugar Maple, Yellow Birch, American Beech
3. Sugar Maple, American Elm

### **Softwood-forest Habitat (H6.2)**

1. White Spruce
2. Spruce, Fir, Pine
3. Pine
4. Spruce, Fir
5. Black Spruce, Larch
6. Spruce, Hemlock, Pine
7. Balsam Fir

### **Mixedwood-forest Habitat (H6.3)**

1. Spruce, Fir, Pine-Maple, Birch
2. Spruce, Fir-Maple
3. White Spruce, Fir-Maple, Birch (Coastal)

TREES	MATURE CLIMAX (YR.)	IMMATURE OLD-GROWTH (YR.)	MATURE OLD GROWTH (YR.)
Eastern Hemlock	80-150	150-200	200+
Eastern White Pine	80-125	125-175	175+
Red Spruce	80-125	125-175	175+
Sugar Maple	80-100	100-150	150+
American Beech	80-100	100-150	150+
Yellow Birch	80-100	100-150	150+

Table H6I.1: Relative age of trees associated with old forests

Figure H6I.1 is a simplified illustration of the successional sequence through which these associations progress as the “fit” between the physical environment and the forest matures. Undisturbed forests may result in one of five or more climax habitats, depending mainly site conditions. Disturbance is usual; either naturally or through harvesting and managing forests.

Table T10.4.1 (in Plant Communities in Nova Scotia) shows the relationship between site characteristics and origin, and the successional or seral stage of the associations.

References

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- 2 Lynds, A. (1992) “Provisional ecological characteristics of old-growth forests for Nova Scotia: An Acadian forest perspective.” In *J.H.M. Willison, ed. Science and the Management of Protected Areas*. Elsevier Science Publishers, Amsterdam.



H6 Introduction to Forests

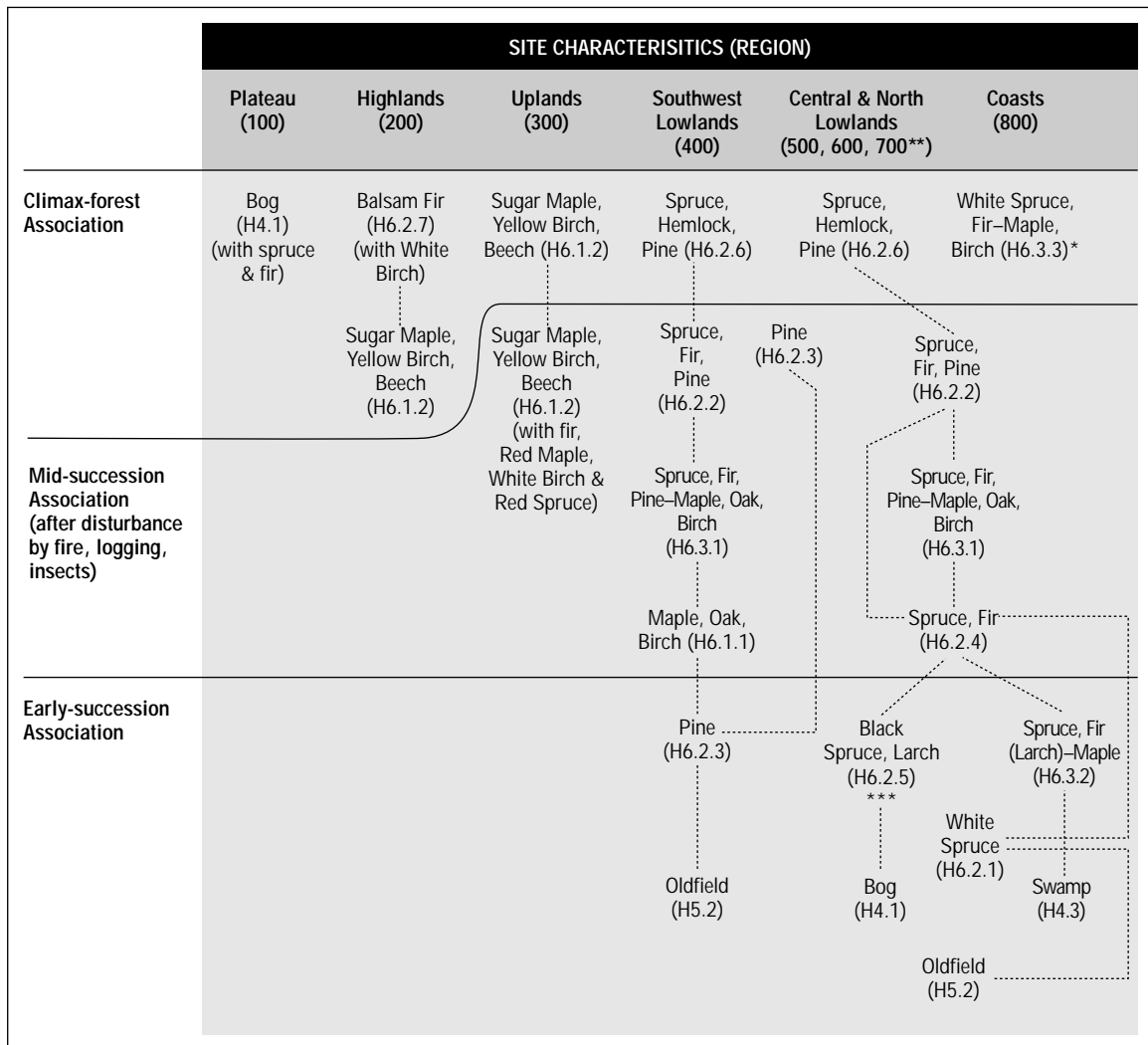


Figure H6I.1: Simplified Forest Succession in Nova Scotia: Generalized successional stages do not reflect detailed information on specific situations. The rate of successional change may be approximated by referring to the life span of the species involved (see T10.6). An exception is the successional sequence in bogs, which occurs more slowly, as it depends on changing hydrological conditions (see H4.1). \*These species may also be part of early- and mid-successional stages, depending on the type and intensity of disturbance. \*\*In Regions 500, 600 and 700, the pine and hemlock component is not typically as significant as in western Nova Scotia (Region 400); spruce and fir tend to predominate in mid- and late-successional stages. \*\*\*Black spruce and larch associations also occur as edaphic climax forest throughout N.S.

## H6.1 HARDWOOD FOREST

Hardwood or deciduous forests are predominantly composed of broad-leaved trees and associated plants.

There are three common associations of hardwood forest:

1. *Maple, Oak, Birch*
2. *Sugar Maple, Yellow Birch, Beech*
3. *Sugar Maple, Elm (Floodplain)*



**Plate H6.1.1:** Secondary succession of Balsam Fir in a disturbed hardwood forest dominated by shade-intolerant Red Maple and White Birch, Cranberry Lake (Unit 433). Photo: A. Wilson.

H6.1

## 1. MAPLE, OAK, BIRCH FOREST

This vegetation type is a predominant early- to mid-successional forest of southwestern Nova Scotia and is mainly the consequence of fire. Young coniferous species (White Pine, Balsam Fir, Red Spruce and Black Spruce) are regularly found developing under its canopy.

### PHYSICAL ASPECTS

1. Bedrock: granite, quartzite, argillite.
2. Soils: shallow, bouldery, sandy loam to loamy sand glacial tills.
3. Relief: drumlinized hills.
4. Drainage: very rapidly to well drained; dry sites.

### SUCCESSIONAL SEQUENCE

Red Maple, Red Oak and White Birch, all low to intermediate in shade tolerance, invade relatively dry sites recently disturbed by fire or logging. These three species usually form an early-successional association, due to their ability to stump-sprout vigorously following a disturbance.

In cases of severe or repeated burning, White Pine and Red Spruce will invade the shaded understory provided by the sprouting hardwoods. Over time, however, spruce and pine will become well established and thus produce a mixedwood or even a pure coniferous forest.

On drumlin fields in southwestern Nova Scotia, shade-tolerant Hemlock and Red Spruce can develop under the mixedwood canopy, eventually overtaking the hardwoods and leading to a near-climax spruce, hemlock, pine association.

In the case of a light fire, Beech remains an important component within the early-successional stages of the maple, oak, birch complex, especially on drumlinoid topography. Because of the less severe disturbance, the successional trend will eventually lead to a climax forest of Sugar Maple, Yellow Birch and Beech.

### PLANTS

The ground vegetation belongs to the Bracken Fern association, typically found in openings and in the less-dense areas of the forest stand. This association is tolerant of many topographic situations. The Bracken Fern almost always typifies a burned area, although evidence has shown it is also associated (to a lesser extent) with windfall and logging distur-

bances. Blueberry, Lambkill, and Bunchberry are subdominant species.

### ANIMALS

The soil fauna is poor, due to the poorly developed dry humus layer. There is, however, a fairly rich fauna in the tree crowns and along the forest margin. The Winter Moth that defoliates hardwood trees was studied in this forest type in the Bridgewater area. Birds include the Ovenbird, Rose-breasted Grosbeak, Red-eyed Vireo, and other small perching birds. White-footed Mouse and Red Squirrel are typical mammals. The young growth can provide cover and browse for Snowshoe Hare and deer.

### DISTRIBUTION

The maple, oak, birch forest is found in the granitic Atlantic Interior, from west of Lake Rossignol to Halifax (Unit 451) and in the bowl-shaped depression around the LaHave River in the south-central portion of Nova Scotia (Units 433, 434). It also occurs scattered throughout much of the southern part of the province elsewhere in Region 400.

## 2. SUGAR MAPLE, YELLOW BIRCH AND BEECH FOREST

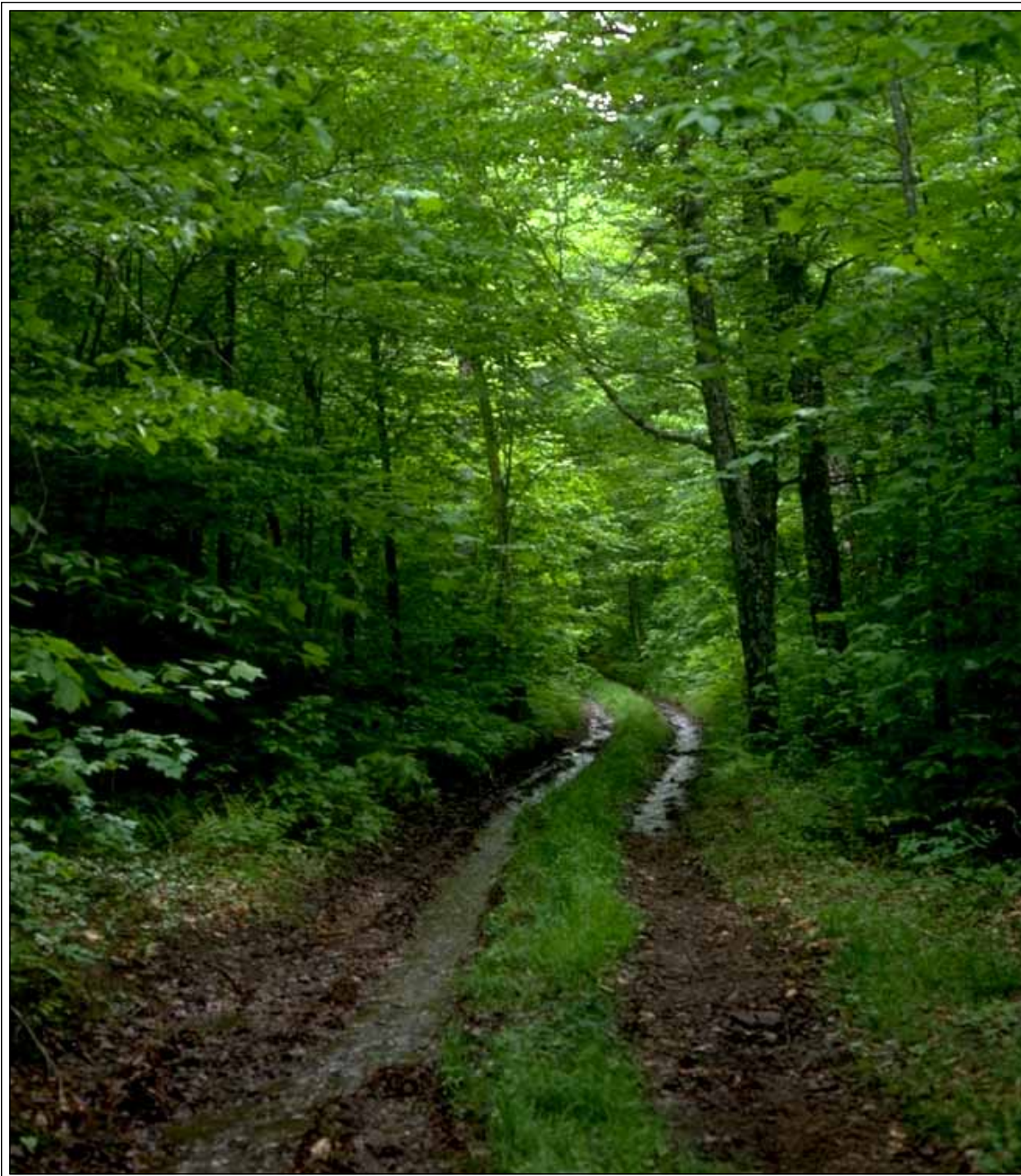
This is the hardwood climax forest of Nova Scotia: climax or near-climax hardwood forest consisting mainly of shade-tolerant hardwoods occurring on higher ground. In North America, Nova Scotia represents the northeastern limit of distribution for this forest.

Associated forest-cover types include

- pure or mixed stands of Sugar Maple, Yellow Birch and beech—well drained, lower to mid-slopes and hilltops
- White Birch, Yellow Birch—steep, mid to upper slopes; coarse rubbly soils
- Sugar Maple, Yellow Birch, beech—Balsam Fir, White and Red spruces, Eastern Hemlock, White Pine—mixedwood found on gravelly, unstable river fans and spurs; along stream ravines; and on previously logged slopes

### PHYSICAL ASPECTS

1. Bedrock: predominantly granite, but occasionally quartzite, sedimentary and metamorphic rocks, often overlain by sedimentary beds.



## H6.1 Hardwood Forest

**Plate H6.1.2:** Old-growth hardwood forest at Fenwick, Cumberland County (Unit 581). Largely composed of Sugar Maple, Yellow Birch and Beech.  
Photo: D. Davis

2. **Soils:** sandy loam to loam-textured glacial tills, moderately deep and generally rich in nutrients and water supply.
3. **Relief:** ranging from the flat-topped uplands of the Cobequid Mountains to the rolling hills and uplands of Musquodoboit, Pictou, and Cape Breton.
4. **Drainage:** rapidly to well drained, with seepage slopes quite common.

### SUCCESSIONAL SEQUENCE

Assuming site conditions are favourable, the major factor influencing the establishment of the Sugar Maple, Yellow Birch, beech forest is disturbance. In well-drained upland sites, the formation of this climax forest will be assured if no further natural or human disturbance takes place.

Vegetation succession is of a secondary nature, brought about by fire, cutting, insect infestation or substrate disturbance (colluvium activity).

Fire within this well-drained, upland forest habitat would probably result in a successional shade-intolerant hardwood stand consisting of Red Maple, White Birch, Aspen, and Beech. These species are able to develop from sucker growth. Eventually the shade-tolerant hardwoods would intrude into the understory and gradually displace the shade-intolerant species. Shade-tolerant softwood species, such as Red Spruce, Balsam Fir and Eastern Hemlock, may also become locally established during this successional sequence.

Cutting practices within this forest habitat could produce a shift from a pure shade-tolerant hardwood forest to a mixedwood stand. Depending on the degree and time of cutting, a component of spruce, fir and pine could regenerate with the Red Maple and White Birch. Over time, this successional sequence will probably, if left undisturbed, revert to the original shade-tolerant hardwood forest. The forest can maintain itself indefinitely by a process of gap replacement.

Insect infestation does not appear to affect this forest as a whole. Insects do, however, greatly influence individual species of this grouping. The *Nectria-Cryptococcus* association ("Beech Scale") has brought about a dramatic decline in the number of beech in Nova Scotia. Birch Dieback (believed to be a stress-related disorder<sup>1</sup>) and several minor pests have also caused a reduction in the vigour and distribution of both White and Yellow Birches (see T10.1 and T11.16).

Rubble-strewn slopes (talus or colluvium slopes) support a White Birch–Yellow Birch forest type (possibly with minor components of softwoods), a mid-successional stage of this climax forest. As the slope stabilizes, Sugar Maple and Beech will begin to occupy the site.

#### PLANTS

Characteristic species include Broom Moss, Schreber's Moss, Mountain and Striped maples, Starflower, Rose Twisted Stalk and Wild Sarsaparilla, Christmas Fern, Hazelnut, Shining Clubmoss, and baneberry.

#### ANIMALS

This climax hardwood forest has rich soils that support a diverse soil fauna, including philomycid slugs and minute snails, such as *Planogyra astericus* and *Striatura exigua*. Rotting logs provide good habitat

for beetles and other insects. Insects are also important in the canopy. Wood Frogs and salamanders are common, as are warblers and woodpeckers. This is an important small-mammal habitat, especially on talus slopes in Cape Breton, where it supports fourteen of the twenty small mammal species recorded in Nova Scotia. The fallen trees can provide dens for bear in the winter. A large diversity of birds inhabit the tree canopy.

#### SPECIAL FEATURES

- Beech Scale
- Birch Dieback disease
- Softwood component in ravine slopes
- Rock Vole, Gaspé Shrew and Southern Bog Lemming on lower levels of old talus slopes in Cape Breton.
- Old forests—The species in this association are long lived and make up some of Nova Scotia's old forests, which are identified in the Nova Scotia Museum Site Files as Sites of Ecological Significance.

#### DISTRIBUTION IN NOVA SCOTIA

The major occurrences of the Sugar Maple, Yellow Birch, Beech forest are found in the Cobequid Mountains, Pictou–Antigonish highlands and north Bras d'Or uplands of Region 300; the slopes and ridges (District 420) and drumlins (District 430) of the Atlantic interior; in higher sections of the Carboniferous lowlands, such as hills and valleys (District 580) and in the Annapolis Valley (District 610). Minor occurrences are scattered throughout the interior of the province.

### 3. SUGAR MAPLE, AMERICAN ELM (FLOODPLAIN) FOREST

The Sugar Maple, American Elm association is the climax forest of floodplains. Valley floors of the larger river systems with rich intervale soils support a great diversity of vegetation. Climax-forest cover consists of Sugar Maple and American Elm, with minor components of birches, Balsam Poplar (limited mainly to northern Cape Breton), White Spruce, willow, Red Maple and American Ash.



Plate H6.1.3: Intervale forest dominated by Sugar Maple along the West Branch of East River, Hopewell, Pictou County (sub-Unit 582a). Photo: A. Wilson.

## FORMATION

When a section of riverbed cannot handle the volume of water it receives, the river may erode a new channel or it may flood its banks. The floodwaters carry and deposit sediment on the floodplain. The level of the floodplain gradually increases, allowing terrestrial vegetation to gain a foothold. Under these conditions the Sugar Maple–American Elm forest becomes established on stable, mature to old-age river floodplains.

## PHYSICAL ASPECTS

1. Bedrock: variable.
2. Soils: sandy to gravelly alluvium (fluvial and/or fluvio-glacial).
3. Relief: flat to very gently undulating, slow-moving sections of rivers.
4. Drainage: well-to-excessively drained.

## SUCCESSIONAL SEQUENCE

The successional sequence within the Sugar Maple, American Elm forest relates to the natural life cycle of the river. As the river matures from a boulder plain to an alluvial floodplain, a corresponding change in moisture regimes (and therefore in vegetation) occurs. The early-successional mesic site generally supports a forest composed of admixtures of Balsam Poplar, White Spruce, White Birch and willow. As the floodplain stabilizes and matures, a climax-forest habitat of Sugar Maple and elm with a minor component of ash represents the change from a hydric to a mesic condition. The lack of this forest in Nova Scotia relates to human disturbance along floodplains.

## PLANTS

Much of the ground vegetation of river floodplains belongs to the Alleghenian floral element. Pockets of this flora are scattered through the central and



northern counties of the Carboniferous lowlands (Region 500) (e.g., Kempton [Unit 572] and South Maitland [Unit 511a]) and in sheltered locations on Cape Breton Island.

The floodplain flora is dominated by the shrubs Speckled Alder, Hazelnut, the hawthorns and Hop-hornbeam; and by the herbs: Bloodroot, Enchanter's Nightshade, Dog's-tooth Violet, Ostrich Fern, Sensitive Fern, Avens, Cow Parsnip, Rough Goldenrod, Tall White Aster, Wood Goldenrod, Dutchman's Breeches, Spring Beauty, Hairy Sweet Cicely, Yellow Violet, Nodding Trillium, Feverwort and Blue Cohosh.

#### ANIMALS

Floodplains are frequently replenished with silt from flooding and with the humus developed from the leaves of deciduous trees. This rich soil provides the basis for soil fauna, which may, however, be inhibited on sites where flooding is too frequent. During the summer, more-active animals invade the habitat from adjacent habitats. Where flooding is infrequent, small-mammal diversity is moderate to high, and population levels can be very high. Toads and salamanders and the Maritime Garter Snake are common. The crowns of the trees support rich insect and bird life. Warblers, vireos, flycatchers, Veery and Yellow-bellied Sapsucker are common in these woods.

#### SPECIAL FEATURES

- Dutch Elm disease.
- Rare floodplain plants.
- Early spring-flowering plants.
- Most northern distribution of Alleghenian floral element.
- Old-forest sites identified in the Nova Scotia Museum Site Files as Sites of Ecological Significance.

#### DISTRIBUTION

The Sugar Maple, American Elm forest is sparsely distributed in Nova Scotia today. It is confined to the larger river floodplains of central Nova Scotia, northern counties of the mainland and Cape Breton Island throughout Region 500. It has been heavily limited by cultivation of the fertile alluvial soils that underlie it and by grazing.



#### Associated Topics

T3.4 Terrestrial Glacial Deposits and Landscape Features, T4 Colonization, T8.2 Freshwater Environments, T9 Soils, T10 Plants, T11.2 Forest and Edge-habitat Birds, T11.9 Carnivores, T11.11 Small Mammals, T11.16 Land and Freshwater Invertebrates, T12.10 Plants and Resources

#### Associated Habitats

H3.1 Open-water Lotic (Rivers and Streams), H5.4 Talus Slope, H6.2 Softwood Forest, H6.3 Mixedwood Forest

#### References

- 1 Forestry Canada (1992) Forest Insect and Disease Conditions in Canada 1989. Forest Insect and Disease Survey.

#### Additional Reading

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- Eastern Ecological Research (1978) Cape Breton Highlands National Park: Ecological Land Classification. Parks Canada.
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## H6.2 SOFTWOOD FOREST

Softwood (or coniferous) forest is mainly composed of needle-bearing trees. There are seven common associations of softwood forest in Nova Scotia:

1. White Spruce
2. Spruce, Fir, Pine

3. Pine
4. Spruce, Fir
5. Black Spruce, Larch
6. Spruce, Hemlock, Pine
7. Balsam Fir



**Plate H6.2.1:** Coastal forest dominated by White Spruce at Canso, Guysborough County (Unit 852). Further inland, Balsam Fir, Red Maple and birch mix with the spruce and form a mixed forest (see H6.3). Photo: Parks and Recreation, DNR

H6.2

## 1. WHITE SPRUCE FOREST

White Spruce is the major early-successional forest colonizing abandoned agricultural lands in Nova Scotia. This tree species has frequent early and heavy seed crops and an ability to grow on bare or nearly-bare mineral soils. Homogeneous stands of this fast-growing species generally occur only in association with oldfield habitats (see H5.2), but White Spruce is also a common species along the coast (see H6.3 White Spruce, Fir-Maple, Birch).

### PHYSICAL ASPECTS

1. Bedrock: all bedrock types.
2. Soils: relatively deep, loam to loamy clay glacial tills with a wide range of acidity conditions.
3. Relief: generally flat to undulating topography characteristic of agricultural lands and on steep-sided sheep pastures in Cape Breton.
4. Drainage: usually associated with well-to-imperfectly drained soils.

### FORMATION

For a site to be favourable for the establishment of White Spruce seedlings, three conditions must be met:

1. a thin layer of humus or recent disturbance of the humus layer to expose bare mineral soil, such as abandoned farmland
2. sufficient moisture to ensure early germination and growth
3. sufficient sunlight

### SUCCESSIONAL SEQUENCE

White Spruce characterizes pioneer forests. Abandoned fields, vegetated by various agricultural grasses, herbaceous annuals and perennials, gradually become speckled with small clumps of White Spruce seedlings. The early-successional stage is very active as the system changes from oldfield to forest. The ecotones with other habitats are normally characterized by abrupt transitions. White Spruce stands can be subsequently invaded by Balsam Fir and shade-tolerant hardwoods, such as Sugar Maple and Beech, or shade-intolerant species, such as Red Maple. Eventually these colonizing species give way to the regional climax forest of that particular area. White Spruce does not reproduce itself successfully under its own overstorey, for it is shade-intolerant. The invasion of other tree species into

the mature White Spruce stand spells the end of this early-successional forest habitat.

### PLANTS

Oldfield herbaceous plants linger for some time under the developing pure White Spruce stands. Schreber's Moss, Hair-Cap Moss and Broom Moss are generally the most important ground vegetation found in low light conditions of maturing stands of oldfield White Spruce. At maturity, ground-cover vegetation is characterized by Stair-step Moss and the liverwort *Bazzania trilobata*.

### ANIMALS

Small-mammal diversity in mature White Spruce forests is lower than in any other forest in Nova Scotia, often only consisting of two species: Red Squirrel and Red-backed Vole. Young stands may provide habitat for Chipping Sparrows, while mature stands provide habitat for foliage-foraging birds, such as kinglets and warblers. Various finches, e.g., siskins and crossbills, feed on seed cones. Snowshoe Hare can be found in young stands, predominantly in the winter. Deer can also inhabit this forest in the winter or after disturbance during other seasons.

### SPECIAL FEATURES

- This forest occurs where agriculture activity has left soil virtually free of rocks, providing suitable conditions for fast and even growth. White Spruce can be accompanied by alders, Larch and/or Balsam Fir as it colonizes abandoned fields.

### DISTRIBUTION IN NOVA SCOTIA

The White Spruce forest association is distributed throughout the province on land that, historically, has been agricultural. This occurs especially in the Carboniferous lowlands in Region 500, in many of the once-active farms in central and northern portions of Nova Scotia, and in coastal areas in eastern Nova Scotia and along the Bay of Fundy.

## 2. SPRUCE, FIR, PINE FOREST

This major forest is widespread across the province. The Red Spruce, Balsam Fir, White Pine asso-

ciation is an early- to mid-successional forest resulting from fire and cutting practices on generally well-drained sites. One of the main features of this habitat is the presence of vertical zonation: an open White Pine overstorey and a dense spruce-fir understorey.

#### PHYSICAL ASPECTS

1. **Bedrock:** mainly sedimentary and metamorphic—shales, slates, siltstones, conglomerates; occasionally found on volcanics and granites.
2. **Soils:** moderately deep, sandy loam to clay loam to gravelly clay loam glacial tills. Occasionally found on shallow soils with bedrock near the surface.
3. **Relief:** variable; flat lowlands and lower slopes to low, rugged hills and upland flats.
4. **Drainage:** drier, well-drained sites to poorly drained flats; on the more poorly drained sites, Black Spruce and fir replace the Red Spruce, fir, pine association.

#### SUCCESSIONAL SEQUENCE

After fire or cutting, spruce, fir, maple and birch, plus relict White Pine, form an early-successional forest. Young White Pine enters the stand on higher, dry hummocks. The hardwoods die from crowding, generally leaving a two-storied spruce, fir, pine stand. There is generally heavy Balsam Fir regeneration within the stand, but Red Spruce is the more abundant species overall. In the right conditions, this association will succeed to a spruce, hemlock, pine association.

It is speculated that the presettlement Acadian forest was dominated by pine in such parts of the province as the interior and south-central Nova Scotia. Repeated fires did not allow for the establishment of other fire suppression species. Today, fire suppression has altered the natural-disturbance regime, allowing for the development of an understorey and the subsequent establishment of the spruce, fir, pine association.

#### PLANTS

The Bracken Fern plant association is usually found in the understorey of this habitat. Bracken Fern, blueberry, Lambkill and Bunchberry are the main components. Schrebers Moss, Broom Moss and the liverworts make up the ground species. Low light conditions encourages the growth of mushrooms and other parasitic/saprophytic plants, such as Indian Pipe.

#### ANIMALS

The accumulation of pine and spruce needles on the ground gives a poor humus layer and an impoverished soil fauna. Insects are most important in the canopy and are food for canopy birds such as warblers. Red-back Salamander, Ring-neck Snake, and Red Squirrel are common. White-throated Sparrow, Nashville Warbler, Magnolia Warbler, Yellow-rumped Warbler and kinglets are summer residents in this habitat. Snowshoe Hare can be found in the younger stands.

#### SPECIAL FEATURES

- Large, old relict White Pine.
- Red Spruce is considered a near-climax to climax (steady-state) species because of its shade tolerance and response when released after severe suppression.

#### DISTRIBUTION IN NOVA SCOTIA

The spruce, fir, pine forest is widespread throughout mainland Nova Scotia and is particularly common in Region 500.

### 3. PINE FOREST

The pine forest is composed of White Pine, Red Pine and Jack Pine. It originates from fire and usually forms pure or mixed stands with other fire-successional species, such as Red Maple, Red Oak, Trembling Aspen, White Birch or Black Spruce. Immature and mature stands do not permit a luxuriant ground-vegetation growth, due to shade and a continuous shower of acidic pine needles that covers the ground surface.

#### PHYSICAL ASPECTS

1. **Bedrock:** variable.
2. **Soils:** occasionally on moderately deep, fresh and well-drained tills of drumlins and eskers but more often on coarse-textured (sandy to bouldery) dry, soils with a very shallow glacial till or a sandy glacial outwash parent material. In many cases, this forest habitat is found on exposed bedrock with a minimal covering of humus.
3. **Relief:** flat to undulating, generally on upland ridges and hills.
4. **Drainage:** rapidly to well drained; usually very dry sites.



Plate H6.2.2: White Pine on an esker ridge near Indian Fields, in Shelbourne County (sub-Unit 412a). Photo: Parks and Recreation Division, DNR.

### SUCCESSIONAL SEQUENCE

The pines seed quickly after an intense fire, particularly on sandy, gravelly or rocky, dry soils. This is especially true of Jack Pine, which requires a great amount of heat to open its seed cones. Repeated burning of most sites will result in the establishment of a predominantly ericaceous type vegetation. If a seed source is readily available, the pines may, in turn, become established.

Seeds are often provided by large relict pines, particularly White Pine, which have survived the devastation of the fire. Depending on the disturbance regime, i.e., severity and frequency of fire, shade-tolerant spruces and Balsam Fir will germinate and grow in the understory of the pine stands. In the end, a near-climax pine-spruce forest will develop. Jack Pine is quickly overtaken by tolerant hardwoods, resulting in a mixedwood forest. In southwestern Nova Scotia, pure stands of White Pine will invade abandoned agricultural land on drumlins. Balsam Fir usually germinates under White Pine.

On dry, coarse, textured material in that part of the province, White Pine can regenerate itself after fire. In the case of repeated fire, the area could remain as a barren habitat for extended periods of times before reverting to a forested habitat.

### PLANTS

Repeated burning or severe fire on dry sandy sites produces a Bearberry–Broom Crowberry and/or Bracken Fern association. When ground vegetation is present in the pine-forest habitat, it is usually the dominant fire plant association found in the province—the Bracken Fern association. Even then, the plants of this association—Bracken Fern, blueberry, Lambkill, Bunchberry and *Cladonia*, to name the dominant species—are found only in forest openings where enough light penetrates to permit their growth.

## ANIMALS

The soil fauna is poor, due to the accumulation of pine needles. Small-mammal diversity and abundance are generally low, with the most common (and sometimes the only) species being Red Squirrels, Red-backed Voles and Cinerous Shrews. Birds include chickadees, warblers and juncos. This forest has characteristic canopy invertebrate species which form the basis for the food supply for large animals. A common example is the White Pine Weevil.

## SPECIAL FEATURES

- Lack of ground vegetation.
- Relict White Pine—one of the oldest living tree stands in the province (the Hemlock is the oldest).
- Jack Pine up to 100 years old on granite in Halifax County and in Neils Harbour, Cape Breton Island (District 210a).
- Old-forest sites as identified in Nova Scotia Museum Sites of Ecological Significance.
- White Pine-forested drumlins (Region 400).

## DISTRIBUTION IN NOVA SCOTIA

This forest habitat is scattered throughout Nova Scotia, but its best development occurs on the stony-sandy soils of Shelburne, Queens and Annapolis counties (Districts 410, 450); on the sandy soils of District 550 in Cumberland County (Jack Pine) and in the fire barrens of northeastern Cape Breton Island (District 210). Stands of Red Pine occur on gravelly to clay loam soils of Stanley (District 540). White Pine stands also occur on drumlins in Lunenburg and Queens Counties (Region 400).

## 4. SPRUCE, FIR FOREST

The spruce, fir forest is a pure mid-successional coniferous forest. It regenerates on moist sites following logging of coniferous forests and occurs as natural stands in a successional sequence on wet depressional sites. This forest can be dominated by Red Spruce or Black Spruce, depending on whether the sites are wet or dry.

## PHYSICAL ASPECTS

1. **Bedrock:** mainly hard metamorphic, igneous and volcanic rock, sometimes overlain by sedimentary deposits.

2. **Soils:** mostly shallow sandy loam to loamy glacial tills, with scattered deposits of marine and estuarine clays, and clay loams developed from basalt bedrock.
3. **Relief:** predominantly found on upland flats and lower slopes and valley bottoms, but also along the coastline of the Bay of Fundy.
4. **Drainage:** generally well-to-imperfectly drained for Red Spruce, and poorly-to-rapidly drained for Black Spruce.

## SUCCESSIONAL SEQUENCE

The spruce, fir mid-successional association can develop from and into a variable number of forest associations. The spruce component can either be Black Spruce, which is tolerant of the extremes of the moister regime, or Red Spruce, which prefers more moderate conditions.

Occasionally, over a very long period of time, the site conditions of the Black Spruce, larch forest can progress from a very wet to a moist condition to a drier, hummocky surface. The Black Spruce component increases at the expense of the shade-intolerant larch and improved drainage allows Balsam Fir, and occasionally Red Spruce, to invade the site and produce a spruce, fir forest association.

This association can also develop from early-successional mixedwood forests. On drier sites where the stand has developed following cutting, White Pine and shade-tolerant hardwoods may later invade.

## PLANTS

The humus-moss plant association is found under the closed canopy of this forest habitat. Schreber's Moss, Broom Moss and the liverwort *Bazzania trilobata* dominate this community. In natural openings or thinnings, a Wood Fern/Wood-sorrel plant association becomes conspicuous, although Schreber's Moss remains dominant. Low light conditions encourage the growth of mushrooms and of parasitic flowering plants, such as Indian Pipe.

## ANIMALS

The acidic humus from spruce and fir needles supports a poor soil fauna; this lack of diversity and scarcity of deciduous trees limits the variety of other animal species, due to the lack of food. Red Squirrel, Red-backed Vole and Short-tailed Shrew may be common. Birds include Spruce Grouse, Yellow-bellied Flycatcher, Dark-eyed Junco and Hermit Thrush.

## SPECIAL FEATURES

- This association has variable successional roles.
- The ground flora in this association is predominantly composed of mosses.

## DISTRIBUTION IN NOVA SCOTIA

The spruce, fir forest is found in depressions throughout southeastern Nova Scotia, on the upland flats, lower slopes and valley bottoms of the Cobequid Hills (Unit 311), the north Bras d'Or uplands (Unit 313), Mabou highlands (Unit 314) and the Pictou–Antigonish highlands (Unit 312). This forest habitat also occupies the coastline and immediate interior of the Fundy coast and North Mountain (Region 700). On the Cape Breton plateau (Region 100)—a high, exposed oval tableland—this forest is present in a stunted, windswept form.

## 5. BLACK SPRUCE, LARCH FOREST

This association is the dominant forest cover of wet depressional areas and edges of bogs (see Plate H4.1.1). It is characterized by generally stunted, open Black Spruce–larch forests with sedge–moss ground cover.

## PHYSICAL ASPECTS

1. Bedrock: generally hard igneous and metamorphic.
2. Soils: organics and moderately coarse to fine glacial tills.
3. Relief: flat to depressional areas.
4. Drainage: poorly-to-very-poorly drained sites.

## SUCCESSIONAL SEQUENCE

The Black Spruce, larch association is the first forest type in the forest succession on moist-to-wet sites. Initially, the area is in a nonforested state, either that of a bog or open water. Over time, as the site becomes built up with organic matter to rise above the water table, the Black Spruce and larch invade. The mature Black Spruce, larch forest attains an edaphic climax condition. Black Spruce and larch can tolerate high-moisture regimes, as well as the acidic nature of the soil (peat) found in association with bogs. The forest will be able to occupy the site indefinitely unless a major change in the soil regime takes place.

## PLANTS

The sedge–moss plant association dominates the ground vegetation in this wet forest habitat. *Carex stricta* and *Sphagnum fallax* dominate the association. In wet-to-moist soils, Cinnamon Fern may become important, along with the Sphagnum. Other common plants are Labrador Tea, Lambkill and Rhodora. Foliose lichens (such as Old Man's Beard) and fruticose lichens commonly adorn the trees.

## ANIMALS

Spruce, Larch forest is more productive at its edges than in the interior, where the soil fauna is poor and poor drainage limits small-mammal species. The use varies seasonally, and most of the mammals are virtually always temporary visitors from adjacent habitats, rather than residents. This forest can provide shelter and browse in the winter. Birds include Canada Warbler, Common Yellowthroat, Olive-sided Flycatcher, Black-backed Woodpecker, Ruby-crowned Kinglet, White-throated Sparrow and Black-and-white warblers.

## SPECIAL FEATURES

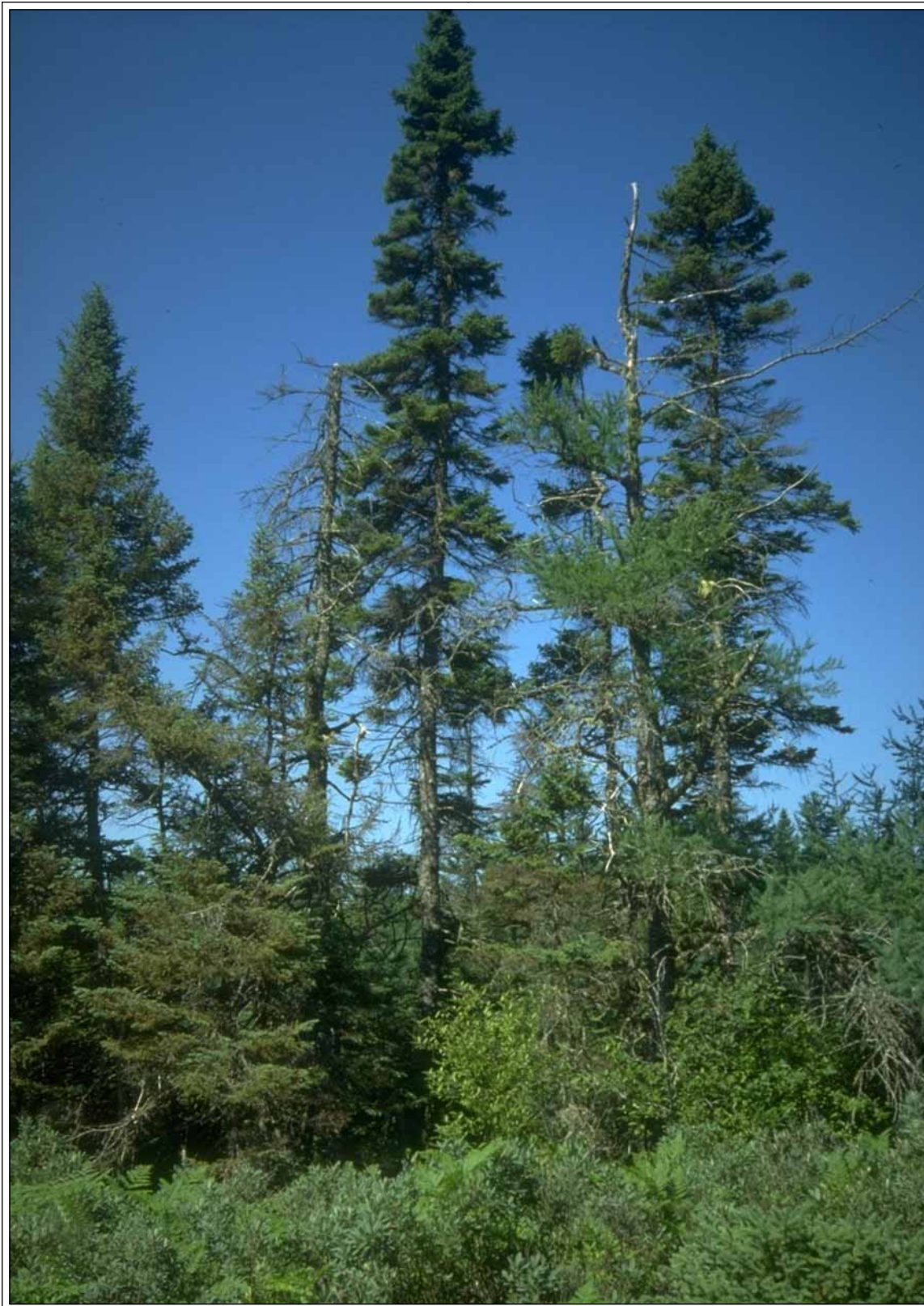
- Stunted growth of spruce and larch due to excessive moisture from nearby bogs.
- Extremely slow-growing forest trees may only be a couple of metres high but may be over 100 years old.
- Edaphic climax conditions.

## DISTRIBUTION IN NOVA SCOTIA

Although usually occupying small areas, the Black Spruce, larch forest is generally found throughout mainland Nova Scotia and Cape Breton Island.

## 6. SPRUCE, HEMLOCK, PINE FOREST

The spruce, hemlock, pine forest is a near-climax or climax (steady-state) forest on moist to relatively-dry sites in much of Nova Scotia. The major species are Red Spruce, Eastern Hemlock and White Pine. Hemlock is no longer the dominant species because of extensive logging operations, combined with its poor regenerative capabilities.



H6.2  
Softwood  
Forest

**Plate H6.2.3:** Mature Black Spruce growing in a wet site near Sable River (sub-Unit 412a). Photo: Parks and Recreation, DNR





Plate H6.2.4: Old-growth spruce, hemlock, pine forest, Sporting Lake Island, Digby County (sub-District 440a). Hemlock regenerating between moss-covered boulders. Photo: O. Maass

#### PHYSICAL ASPECTS

1. Bedrock: variable.
2. Soils: generally shallow, coarse, bouldery sandy loam to clay glacial tills.
3. Relief: lowland flats to broad, flat, upland areas; lower slopes of low, rugged drumlin complexes. Also found on steeper slopes along water courses.
4. Drainage: rapidly to well drained.

#### SUCCESSIONAL SEQUENCE

The near-climax or climax spruce, hemlock, pine forest can develop from the mid-successional spruce, fir, pine forest. The removal of pine and fir by insect and porcupine damage and/or logging from the spruce, fir, pine forest would probably allow invasion by the tolerant Eastern Hemlock, providing a seed source is available. Once the hemlock is established, the three dominant coniferous species vie for space. Insect or wildlife damage can alter the balance and allow for one to predominate in pockets.

#### PLANTS

The ground vegetation consists mainly of a humus-moss association, with Schreber's Moss (*Pleurozium schreberi*), Broom Moss (*Dicranum* spp.) and liverwort (e.g., *Bazzania trilobata*) as codominants. This plant association is particularly prevalent on hummocky sites. Any significant increase in the amount of light reaching the ground surface would allow for invasion by any number of herbaceous plant species, depending on a source of seed.

#### ANIMALS

Although the soil is acid, it supports a soil fauna characterized by native species including beetles, snails and slugs. This fauna is particularly found on and around rotting fallen trees. Small mammals include Red-backed Vole, Short-tailed Shrew and Red Squirrel. Redback Salamander and Ringneck-Snake may be common. The old forest of this association also includes snags, standing trees that are



Plate H6.2.5: Stand of Balsam Fir surrounding French Lake in Inverness County (sub-District 210a). Photo: D. Lawley

utilized by woodpeckers and provide cavities for hole-nesting birds and den sites for mammals.

#### SPECIAL FEATURES

- Pure hemlock stands in canyons of northeast Cape Breton.
- Hemlock is the longest-living tree species in Nova Scotia.

#### DISTRIBUTION IN NOVA SCOTIA

This forest is only extensive in southwestern Nova Scotia, although pockets are scattered throughout the province. It has been greatly reduced by cutting.

### 7. BALSAM FIR FOREST

Balsam Fir is the climax association of the boreal forest in Nova Scotia. The Balsam Fir association has a very low diversity of tree species. Eighty per

cent of the forest is dominated by mature, relatively dense Balsam Fir. With an admixture of White and Black spruce, Mountain Ash and White Birch, the influence of altitude and wind limit tree height and growth much more than on lowland sites. Fauna and ground vegetation are also characterized by a very limited number of species.

#### PHYSICAL ASPECTS

1. Bedrock: granite, gneiss and schist.
2. Soils: mostly stony, deep and/or compacted glacial till with minor occurrences of exposed bedrock-patchy glacial till. Organic soils are scattered throughout.
3. Relief: occurring at elevations of 1000–1700 feet (300–500 m) above sea level. The typical topography for this forest habitat ranges from a flat terrain to hilly complexes.
4. Drainage: this forest type occurs on the complete spectrum of soil-drainage classes, from rapidly to poorly drained.

## SUCCESSIONAL SEQUENCE

The early-successional forest following disturbances in this climax boreal forest is a mixed forest dominated by White Birch and Balsam Fir. As the birch grows and provides more ground shading, Balsam Fir seedlings become more dominant in the understory. The short-lived White Birch begin to die back, allowing the Balsam Fir to mature and develop into a climax forest.

## PLANTS

This moist, dense coniferous-forest habitat favours a ground cover predominantly composed of mosses and liverworts: Schreber's Moss, Broom Moss, Stair-step Moss and the liverwort, *Bazzania trilobata*. As openings occur in the canopy of the forest stand, herbaceous species, such as the Wood Fern, Wild Lily-of-valley, Twinflower, wood-sorrel, Wild Sarsaparilla, Clintonia, Goldthread, Bunchberry and Wood Aster, gain prominence.

## ANIMALS

The fauna of the Balsam Fir forest is impoverished, due to a thin humus layer and low plant diversity. Small-mammal diversity is low. Red-backed Vole, Deer Mouse, Red Squirrel and Common Shrew are the characteristic species. Birds include the Grey-cheeked Thrush and the Blackpoll Warbler.

## SPECIAL FEATURES

- Shorter growth of Balsam Fir, due to wind exposure.
- Old, relict White Spruce is scattered throughout this forest.
- Balsam Fir grows in association with Yellow Birch on higher plateaus in the Cape Breton highlands, as a transitional zone between the Balsam Fir boreal and pure hardwood stands on the canyon slopes. The stands may contain minor components of Sugar Maple, Red Maple and White Birch.

## DISTRIBUTION IN NOVA SCOTIA

The Balsam Fir (boreal) forest in Nova Scotia is confined to the highland area of Cape Breton (District 210).



## Associated Topics

T5 Climate, T9 Soils, T10 Plants, T11.2 Forest and Edge-habitat Birds, T11.11 Small Mammals, T12.10 Plants and Resources

## Associated Habitats

H4.1 Bog, H4.3 Swamp, H5.1 Barren, H5.2 Oldfield, H6.1 Hardwood Forest, H6.3 Mixedwood Forest.

## Additional Reading

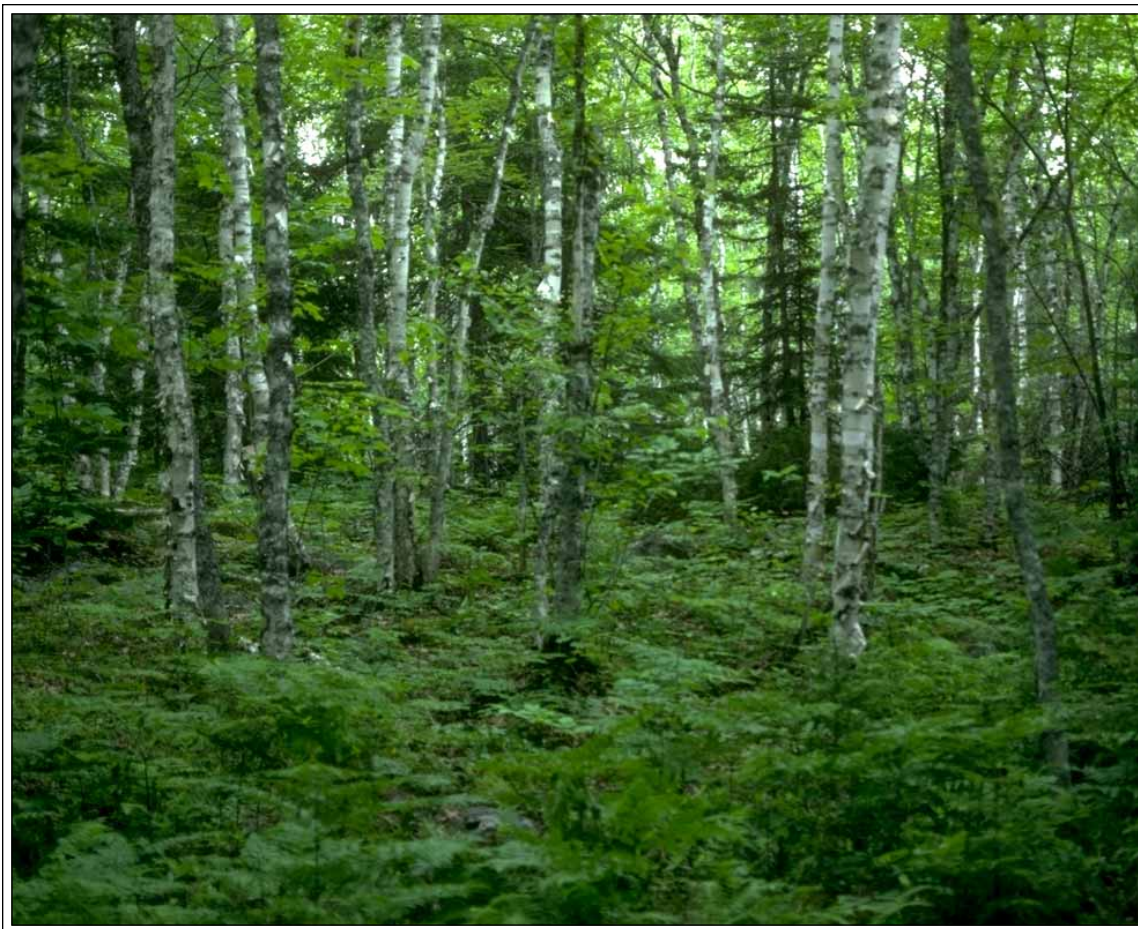
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## H6.3 MIXED FOREST

Mixedwood forests are composed of both hardwood and softwood tree species. There are three common associations of mixedwood forest in Nova

Scotia:

1. Spruce, Fir, Pine-Maple, Birch Forest
2. Spruce, Fir-Maple Forest
3. White Spruce, Fir-Maple, Birch (Coastal) Forest



H6.3  
Mixedwood  
Forest

Plate H6.3.1: Mixed forest south of Torbrook Mines, Annapolis County (sub-Unit 422b). Photo: D. Davis

## 1. SPRUCE, FIR, PINE–MAPLE, BIRCH FOREST

The Red Spruce, Balsam Fir, White Pine–Red Maple, White Birch forest is an early-successional complex found on logged or burned, moist sites. It thrives on disturbance and (depending on seed sources and site conditions) this forest probably has more composition variables than any other in the province. Red Spruce, Black Spruce, Balsam Fir and White Pine dominate the upperstorey, with the shade-intolerant hardwoods Red Maple, White Birch and aspens representing minor components.

### PHYSICAL ASPECTS

1. **Bedrock:** mainly occurring on hard igneous and metamorphic rock, except in the Windsor Lowlands (Unit 511) where it is present on shales and sandstones.
2. **Soils:** shallow to moderately deep coarse (sometimes bouldery) sandy loams to clayey glacial tills.
3. **Relief:** gently undulating lowlands to knoll–hummock complex to ridges.
4. **Drainage:** dry to moist, lower seepage slopes depending on whether in the Black Spruce or Red Spruce phase.

### SUCCESSIONAL SEQUENCE

The spruce, fir, pine–maple, birch forest follows cutting or fire in the predominantly coniferous spruce, hemlock, pine climax forest, or within the regional coniferous forest, such as pine. The major tree species in this habitat type are a mixture of shade-intolerant and -tolerant, but all do well in open conditions during the initial establishment. Species composition can vary considerably between the softwoods and shade-tolerant hardwoods, depending on the severity of the fire or type and extent of cutting. Where soils underlying this forest type are infertile, successive fires through spruce, fir, pine–maple, birch forests may lead to permanent changes in soil conditions and to the formation of a barrenland vegetation type. The association may also originate from progressive long-term successional change in spruce, fir–maple forests. Assuming seed sources are available, hemlock and shade-tolerant hardwood species eventually find their way into most mature spruce, fir, pine–maple, birch stands.

### PLANTS

Ground vegetation consists of the Bracken Fern plant association, which includes Bracken Fern, Blueberry, Sheep-Laurel and Bunchberry. On wet sites, Black Spruce is more common.

On more fertile, upland sites, such as in the northern part of the province, Red Spruce dominates. The ground vegetation is a combination of moss and herbaceous-plant communities. Along watercourses, there tends to be a higher percentage of herbaceous plants.

### ANIMALS

The soil and insect fauna are generally poor. Small passerines and canopy birds such as warblers are important. The small-mammal population has low diversity and low density. In winter, this forest could provide browse for Snowshoe Hare and deer.

### SPECIAL FEATURES

- Cutting and fire disturbance —invasion of intolerant hardwood.
- Relict large, old White Pine, spruce and Fir scattered throughout.

### DISTRIBUTION IN NOVA SCOTIA

This forest is widespread across the province but predominates in the southwest part of the Atlantic interior (Region 400) and also, to a lesser degree, in the Windsor lowlands (Unit 511).

## 2. SPRUCE, FIR–MAPLE FOREST

The Black Spruce, Balsam Fir–Red Maple forest generally occurs in catchment areas where the water table varies considerably throughout the year. It is an early-successional stage, leading eventually to the regional climax forest of the area. Occasional minor components of this habitat are Red Spruce, Eastern Hemlock, pines and Larch; the first three occur on the drier sites and Larch occurs on the wettest sites. This forest can be associated with swamps (see H4.3) and, in the right conditions, can attain an edaphic climax state.

## PHYSICAL ASPECTS

1. **Bedrock:** variable; mainly occurring on hard igneous and metamorphic rock, except in the Windsor–Truro lowland, where it is present on shales and sandstones.
2. **Soils:** shallow to moderately deep, moderately coarse to moderately fine glacial tills.
3. **Relief:** gently undulating lowlands and depressions in knoll–hummock complexes between ridges.
4. **Drainage:** imperfectly to well drained.

## SUCCESSIONAL SEQUENCE

The spruce, fir–maple forest can occur within a number of site conditions. After cutting, the spruce, fir forest will often regenerate as spruce, fir–maple. In drier conditions, the shade-intolerant hardwoods are overtaken by the maturing spruce and fir. The short-lived Balsam Fir dies back as the forest succeeds towards the regional climax association.

On moist sites, the maple may be dominant at the expense of the coniferous species. The forest can maintain itself as a Black Spruce, Balsam Fir–Red Maple association unless site conditions alter the drainage pattern.

During the long-term transition from hydric to mesic conditions, the spruce, fir–maple forest will replace the periodically inundated spruce, larch, maple forest. Balsam Fir and Red Maple are shade-tolerant trees. Larch, while preferring similar wet conditions, is shade-intolerant. As the soil nutrient status improves with drier ground, Balsam Fir colonizes the understorey, eventually shading out the Larch. Fir is shade-tolerant and thrives under a closed canopy of spruce and Larch. This slightly drier habitat will then support a spruce, fir–maple stand.

## PLANTS

The typical understorey plant community is the Cinnamon Fern association. A wide variety of herbaceous plants and shrubs can be found within the community, some in wet pockets and others on hummocks. Sphagnum mosses can also be found in the wetter areas.

## ANIMALS

Small-mammal diversity is low to moderate. The White-footed Mouse, Red-backed Vole, Cinerous and Short-tailed shrews, and Red Squirrel are the characteristic species towards the end of the successional sequence. Warblers, chickadees, junco, thrushes and White-throated Sparrows are common.

## SPECIAL FEATURES

- Two rare plants in Nova Scotia are known from this habitat: Dwarf Chain Fern in southwestern Nova Scotia and Marsh Marigold from northern Nova Scotia.
- The spruce, fir–maple association can occur as an edaphic climax forest controlled by topographic features and drainage. In this situation, the forest maintains itself in wet depressional areas with seepage and running water.

## DISTRIBUTION

The spruce, fir–maple forest is scattered throughout the province but can be found mainly in the southwest portion of the Atlantic Interior (Region 400) and in the Windsor Lowlands (Unit 511).

## 3. WHITE SPRUCE, FIR–MAPLE, BIRCH (COASTAL) FOREST

The White Spruce, Balsam Fir–Red Maple, White Birch forest is the climax forest of the province's rocky and exposed southwestern to northeastern coastline. Trees exhibit stunting and “krummholz”, due to severe wind exposure and salt spray. The forest exhibits zonation tendencies, with the salt-tolerant White Spruce providing a protective belt for the less-resistant fir and hardwoods.

## PHYSICAL ASPECTS

1. **Bedrock:** variable; but mainly granite and quartzite.
2. **Soils:** shallow sandy loam glacial tills alternating with exposed bedrock.
3. **Relief:** coastal bluffs and headlands.
4. **Drainage:** generally imperfectly-to-well drained.

## SUCCESSIONAL SEQUENCE

The seacoast causes a very dynamic and often-changing habitat. In these unique conditions, White Spruce can colonize this habitat because of its tolerance to salt spray and wind. (White Spruce tends to have thick, dense branches.) Balsam Fir is found further inland, behind the protection of the White Spruce. Red Maple and White Birch may be found inland with the fir and spruce, as a result of fire or cutting activities.

## PLANTS

The ground cover under a closed forest canopy is characterized by the Schreber's Moss association. Here, Schreber's Moss and broom moss totally dominate the vegetation. When openings or thinnings in the canopy occur, a more herbaceous plant association occupies the ground. This Wood Fern/Wood-sorrel association consists of the dominant Wood Fern, Wood Sorrel and Schreber's Moss, along with the subdominants Broom Moss, Wild Lily-of-the-valley, Starflower, Goldthread, Clintonia, Bunchberry and Wood Aster.

## ANIMALS

Soil and other animal communities are poorly developed. Red Squirrel may be common. On some islands, the trees are used as nesting sites and roosts for seabirds, such as cormorants, Common Eiders and herons. The dropping from these birds speeds the demise of the trees that are living in a very exposed habitat.

## SPECIAL FEATURES

- "Krummholz" forest —wind-swept trees with branches growing mostly on lee side.
- White Spruce—most salt-tolerant of native tree species.
- The coastal forest around the Bay of Fundy is dominated by Red Spruce and Yellow Birch.

## DISTRIBUTION IN NOVA SCOTIA

The White Spruce, fir-maple, birch forest grows along the fog-bound southwestern coast from Digby to the northeastern coast of Cape Breton Island (Region 800) and on the coastal bluffs and headlands around the Bay of Fundy (Region 700) and components of Regions 300, 500 and 600.

Along the eastern coast from Halifax north, Black Spruce assumes as much importance as Balsam Fir in the second zone of the forest stand.

In coastal headlands and bluffs of eastern Cape Breton (Districts 210, 530, 550), the little alpine form of Balsam Fir (*Abies balsamea* var. *phanerolepis*) grows right next to the sea on cliffs and barrens in "krummholz" association with White Spruce. *Betula cordifolia* is the dominant birch species in this eastern Cape Breton coastal area. *B. papyrifera* and *B. alleghaniensis* do occur, but not with such frequency or population density.



### Associated Topics

T2.2 Avalon and Meguma Zones, T5 Climate, T9 Soils, T10 Plants, T11.2 Forest and Edge-habitat Birds, T11.7 Seabirds and Birds of Marine Habitats, T11.10 Ungulates, T11.11 Small Mammals, T11.16 Land and Freshwater Invertebrates, T12.10 Plants and Resources

### Associated Habitats

H4.3 Swamp, H5.1 Barren, H6.1 Hardwood Forest, H6.2 Softwood Forest

### Additional Reading

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