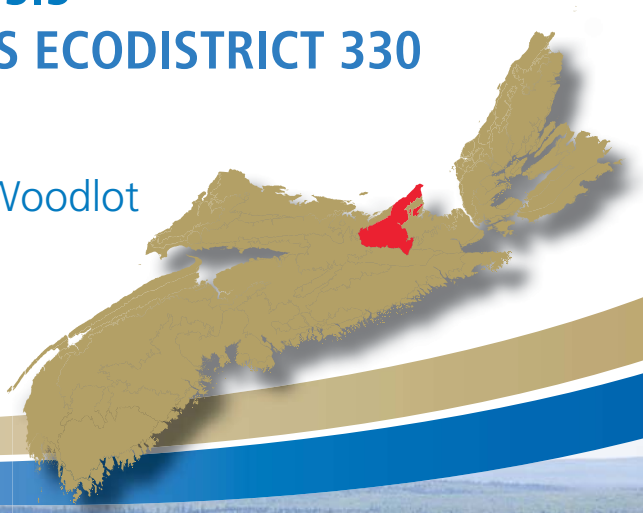
Department of Natural Resources

# ECOLOGICAL LANDSCAPE ANALYSIS
# PICTOU ANTIGONISH HIGHLANDS ECODISTRICT 330

**PART 1**: Overview of Ecodistrict
**PART 2**: Linking the Landscape to the Woodlot



ELA 2015-330

NOVA SCOTIA

***Ecological Landscape Analysis, Ecodistrict 330: Pictou Antigonish Highlands***

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This report, one of 38 for the province, provides descriptions, maps, analysis, photos, and resources of the Pictou Antigonish Highlands Ecodistrict.

The Ecological Landscape Analyses (ELAs) were analyzed and written from 2005 – 2009. They provide baseline information for this period in a standardized format designed to support future data updates, forecasts, and trends. The original documents are presented in three parts: Part 1 – *Learning About What Makes this Ecodistrict Distinctive* – and Part 2 – *How Woodland Owners Can Apply Landscape Concepts to Their Woodland.* Part 3 – *Landscape Analysis for Forest Planners* – will be available as a separate document.

Information sources and statistics (benchmark dates) include:

- Forest Inventory (1997 to 1999) – stand volume, species composition
- Crown Lands Forest Model landbase classification (2006) – provides forest inventory update for harvesting and silviculture from satellite photography (2005), silviculture treatment records (2006) and forest age increment (2006)
- Roads and Utility network – Service Nova Scotia and Municipal Relations (2006)
- Significant Habitat and Species Database (2007)
- $\frac{35}{17}$ Atlantic Canada Data Conservation Centre (2013)

**Conventions**

Where major changes have occurred since the original ELA report was written, the new information will be provided in *italics,* so that the reader can see how some conditions have changed since the benchmark date of the ELA.

A glossary of definitions is provided for words that are underlined.

REPORT FOR ELA 2015-330

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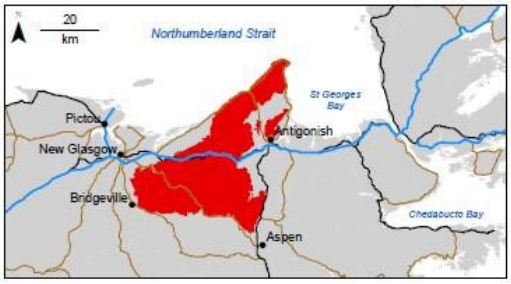
**A NOVA SCOTIA DEPARTMENT OF NATURAL RESOURCES PUBLICATION**

# Ecodistrict Profile

## Ecological Landscape Analysis Summary
## Ecodistrict 330: **Pictou Antigonish Highlands**




An objective of ecosystem-based management is to manage landscapes in as close to a natural state as possible. The intent of this approach is to promote biodiversity, sustain ecological processes, and support the long-term production of goods and services. Each of the province's 38 ecodistricts is an ecological landscape with distinctive patterns of physical features. (Definitions of underlined terms are included in the print and electronic glossary.)

This Ecological Landscape Analysis (ELA) provides detailed information on the forest and timber resources of the various landscape components of Pictou Antigonish Highlands Ecodistrict 330. The ELA also provides brief summaries of other land values, such as minerals, energy and geology, water resources, parks and protected areas, wildlife and wildlife habitat.

This ecodistrict has been described as an elevated triangle separating the Northumberland Lowlands Ecodistrict 530 of Pictou County from the St. Georges Bay Ecodistrict 520 lowlands of Antigonish County.

Generally, the highlands at their summit become a rolling plateau best exemplified by The Keppoch, an area once extensively settled and farmed. The elevation in the ecodistrict is usually 210 to 245 metres above sea level and rises to 300 metres at Eigg Mountain.

The total area of Pictou Antigonish Highlands is 133,920 hectares. Private land ownership accounts for 75% of the ecodistrict, 24% is under provincial Crown management, and the remaining 1% includes water bodies and transportation corridors.

A significant portion of the highlands was settled and cleared for farming by Scottish settlers beginning in the late 1700s with large communities at Rossfield, Browns Mountain, and on The Keppoch. However, with the abandonment of these farms starting shortly after World War One and continuing as the rural population moved to urban centres, most of theselands are now back in a forested condition, often in stands of white spruce.

On the plateau portions of the Pictou Antigonish Highlands, Scottish settlers of the 1800's cleared the forest for farming which when abandoned reverted to white spruce forests.

Influenced by high elevations, the ecodistrict has late, cool springs, cold winters, and low annual temperatures.

Nearly 90% of the ecodistrict is forested. Current and potential old growth forest habitat has been identified for this ecodistrict, which will benefit a variety of wild species, including moose, as well as interior forest species that cannot tolerate forest fragmentation, and cavity nesters such as some of the song birds and owls. Winter surveys for owls in 2006 indicated a relatively large population of barred owls – the most common type of owl in Nova Scotia – in this ecodistrict.

Much of the province's geological history can be viewed in this ecodistrict, including ancient volcanoes and the fossils at Arisaig that are more than 400 million years old.

Fossils more than 400 million years old can be found in the cliffs along the Northumberland Strait near Arisaig.

Landscapes are large areas that function as ecological systems and respond to a variety of influences. Landscapes are composed of smaller ecosystems, known as elements. These elements are described by their physical features – such as soil and landform – and ecological features – such as climax forest type. These characteristics help determine vegetation development.

Element descriptions promote an understanding of historical vegetation patterns and the effects of current disturbances. This landscape analysis identified and mapped seven key landscape elements – one dominant matrix element, five smaller patch elements, and a corridor element – in Pictou Antigonish Highlands.

**Tolerant Hardwood Hills** is the matrix element, representing 64% of the ecodistrict. This element represents shade-tolerant hardwoods, such as sugar maple, yellow birch, and beech, typical of the Acadian Forest. This type of forest can be seen on the slopes along the Trans-Canada Highway in the Marshy Hope area.

**Red and Black Spruce Hummocks** is the largest patch element, generally found on the plateau-like top of the ecodistrict. Red spruce is usually found on well-drained soils while black spruce is more likely found on soils that are wetter.

The other patch elements, in order of size, are **Tolerant Mixedwood Hills**, **Tolerant Mixedwood Slopes**, and **Floodplain.** *A tiny Wetlands element is also part of the ecodistrict.*

**Valley Corridors** is a linear corridor element associated with the major watercourses in the ecodistrict.

## Forest Ecosystem Management
## **For Pictou Antigonish Highlands Ecodistrict**

The primary ecological goals of ecosystem-based management are to maintain and conserve ecosystem biodiversity, productivity, and resilience. Integration of economic, ecological, and social values within a single planning process provides opportunities for creative solutions to meet the challenges of sustainable resource management. By maintaining their integrity, ecosystems can better adapt to environmental stressors such as extended cycles of climate change, atmospheric pollution, changes in land use and vegetation cover.

This ELA provides detailed information on the resources and descriptions of various components of the landscape for Pictou Antigonish Highlands Ecodistrict 330. Resources and their components include the natural elements that make up the landscape and may affect functions like connectivity – how a landscape enables or impedes movement of resources, such as water and animals – as well as conditions of forest composition, road density, and land use intensity.

Only brief summaries are presented for other land values, including minerals, energy and geology, water resources, parks and protected areas, wildlife and wildlife habitat. These summaries are included in the document to present the range of land values that must be balanced during the design stage of the land management process and are not intended to be exhaustive treatments of the respective land values. Where possible, the reader will be referred to additional sources for detailed information.

### Application

The data in this ELA does not represent current inventory, but instead provides baseline conditions for the time when the report was researched, which in the case of the Pictou Antigonish Highlands Ecodistrict was up to 2006. These baseline measurements can be used to assess trends through comparison with present and future inventories.

The ELA supports an approach to maintaining healthy ecosystems by mimicking natural conditions. The report describes the inherent natural structure and condition of landscapes based on enduring physical features, such as elements. It goes on to show how this structure may influence ecosystem functions, such as wildlife movement and connectivity. The ELA summarizes conditions of ecosystems such as forest composition, land use intensity, and road density at the time the report was written.

Finally, the relationship between inherent structure and existing conditions is used to guide future direction. The ELA is part of an ecosystem approach that will expand to encompass other initiatives of Department of Natural Resources (DNR), such as The Path We Share: A Natural Resources Strategy for Nova Scotia 2011 - 2020 (http://novascotia.ca/natr/strategy/pdf/Strategy_Strategy.pdf).

The intention is to describe important ecological characteristics to consider during resource planning – the ELA is not a plan in itself.

# Part 1: An Overview of Pictou Antigonish Highlands – *Learning About What Makes This Ecodistrict Distinctive*

This first part of the report provides an overview of the ecodistrict for a broad readership. By reviewing several key topics, the reader will have a better understanding of the features that help give the area its character and set it apart as a distinct and unique ecodistrict.

## Ecodistrict Characteristics

The Pictou Antigonish Highlands Ecodistrict – on the uplands of northeastern mainland Nova Scotia – is 133,920 hectares in size and forms part of the Nova Scotia Uplands Ecoregion, which stretches from Cumberland County in mainland Nova Scotia to Kellys Mountain in Cape Breton.

The ecodistrict comprises elevated, relatively resistant strata, with elevations generally between 210 to 245 metres, rising to 300 metres at Eigg Mountain. Summit areas are characterized by rolling plateaus.

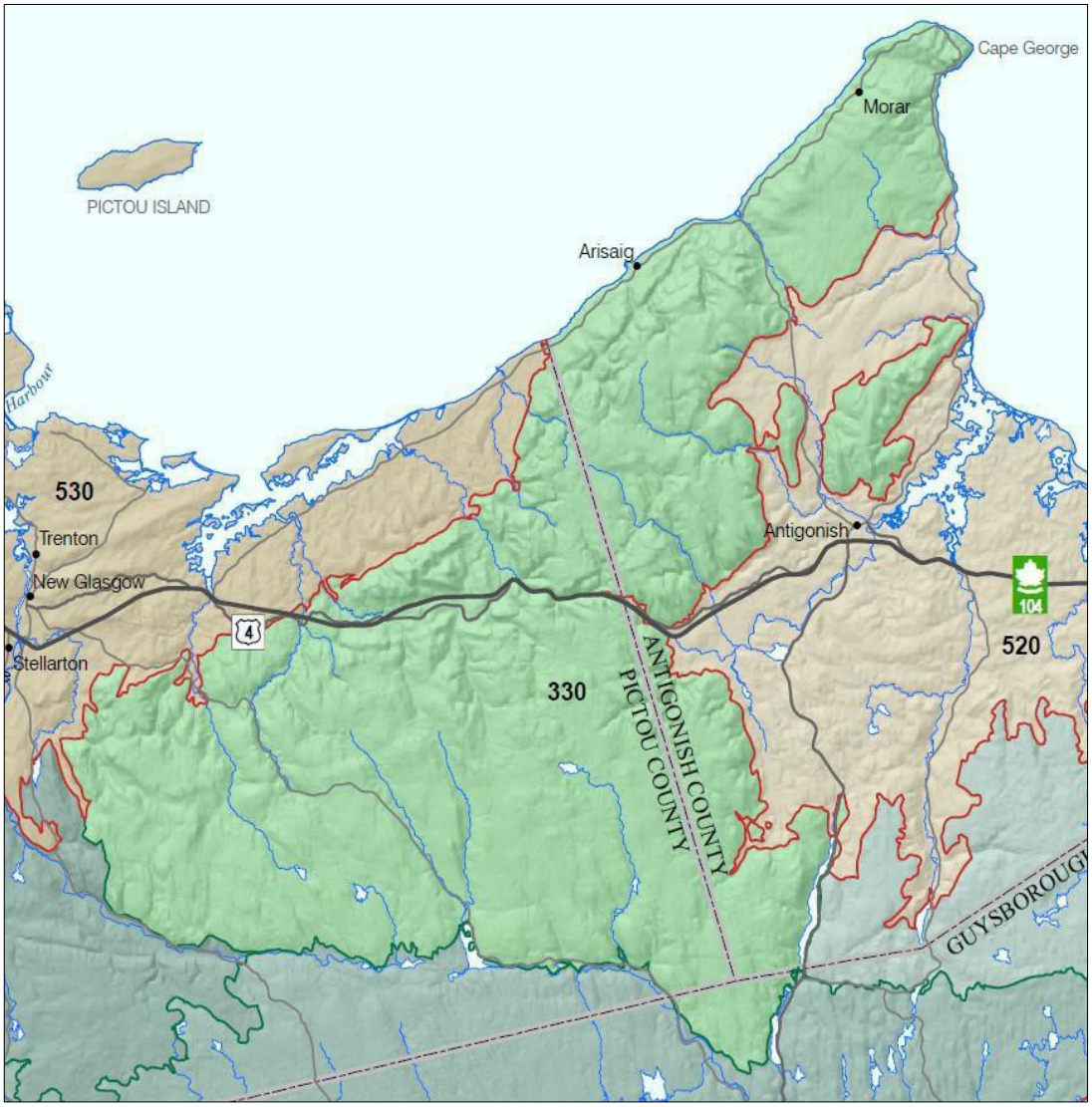
Topographic variation in this upland area is largely controlled by geological structures such as faults and folds. The two most notable of these features are the Cobequid-Chedabucto Fault, which forms the southern boundary of the ecodistrict, and the Hollow Fault, which is located in the northern portion of the ecodistrict. The area between the two major faults is dissected by smaller faults which, in some cases, have resulted in the formation of narrow valleys.

Typical of upland ecodistricts, wetlands, and lakes are relatively small and few in number. Most of Pictou Antigonish Highlands is well-drained with the exception of imperfectly drained soils located around Greendale Loch, Sutherlands Lake, north of Eden Lake and the southern portion of The Keppoch. The dominant soil types are fairly stony, sandy loams and soil derived from shales.

A large portion of this ecodistrict has a climax forest condition characterized by yellow birch, sugar maple, and beech. Red spruce, white spruce, hemlock, and balsam fir are scattered on upland areas, forming mixedwood to coniferous stands on the lower slopes and valley bottoms. Red spruce is less common toward the eastern side of the ecodistrict. Black spruce is predominately found on the imperfectly drained sites.

A significant portion of the highlands was settled and cleared for farming starting in the late 1700s. Much of this settled land was once covered with tolerant hardwood forests (e.g. The Keppoch, Rossfield and Georgeville) on fertile, well-drained soils. The abandonment of these farms started shortly after World War One and has continued until most of these lands are now in a forested condition. The initial re-established forest primarily comprises white spruce.

See map on following page for overview of the Pictou Antigonish Highlands Ecodistrict, including adjacent ecodistricts, locations of area towns and villages, county boundaries, and major waterways.




The Pictou Antigonish Highlands Ecodistrict is located on the uplands of northeastern mainland Nova Scotia. (From Ecodistricts of Nova Scotia map 2007)

## Land Area

The Pictou Antigonish Highlands is one of eight ecodistricts in the Nova Scotia Uplands Ecoregion. The ecodistrict is rural with private ownership accounting for 75% of the area and Crown ownership at 24% (Table 1).

**Table 1 – Land Area by Ownership in the Pictou Antigonish Highlands Ecodistrict***

| Ownership | Area (hectares) | Percent of Total Area |
|---|---|---|
| Provincial Crown land | 31,935 | 23.8 |
| Private | 100,127 | 74.8 |
| Federal | 0 | 0 |
| Aboriginal | 0 | 0 |
| Other (Includes inland water bodies and transportation corridors) | 1,858 | 1.4 |
| **Total** | **133,920** | **100** |

*Note: Figures may vary slightly from table to table because of rounding, averaging, and overlapping of categories and other factors.

## IRM Resource Classification for Provincial Crown Lands

The Integrated Resource Management (IRM) classification for Crown lands was developed through a public consultation process during the strategic phase of IRM completed in 2002.

Table 2 provides a summary of Crown lands designated as either C1, General Resource Use; C2, Multiple and Adaptive Use (allows most uses, but special management may be required); or C3, Protected and Limited Use (such as beaches and sites of cultural and historic significance). In Pictou Antigonish Highlands, the main categories are C2 (73%), C1(26%), and C3 (1%).

**Table 2 – IRM Land Use Categories for Provincial Crown Lands in Ecodistrict**

| IRM Land Use Category | Hectares | Percent of Crown Lands |
|---|---|---|
| C1 – General Resource Use | 8,318 | 26.1 |
| C2 – Multiple and Adaptive Use | 23,412 | 73.3 |
| C3 – Protected and Limited Use | 199 | 0.6 |
| Unclassified | 0 | 0 |
| **Total** | **31,929*** | **100** |

**Note: At the time statistics were generated, the Eigg Mountain – James River Wilderness Area was not entered into the GIS database. See Parks and Recreation / Protected Areas section for a description of the wilderness area.*

## Forests

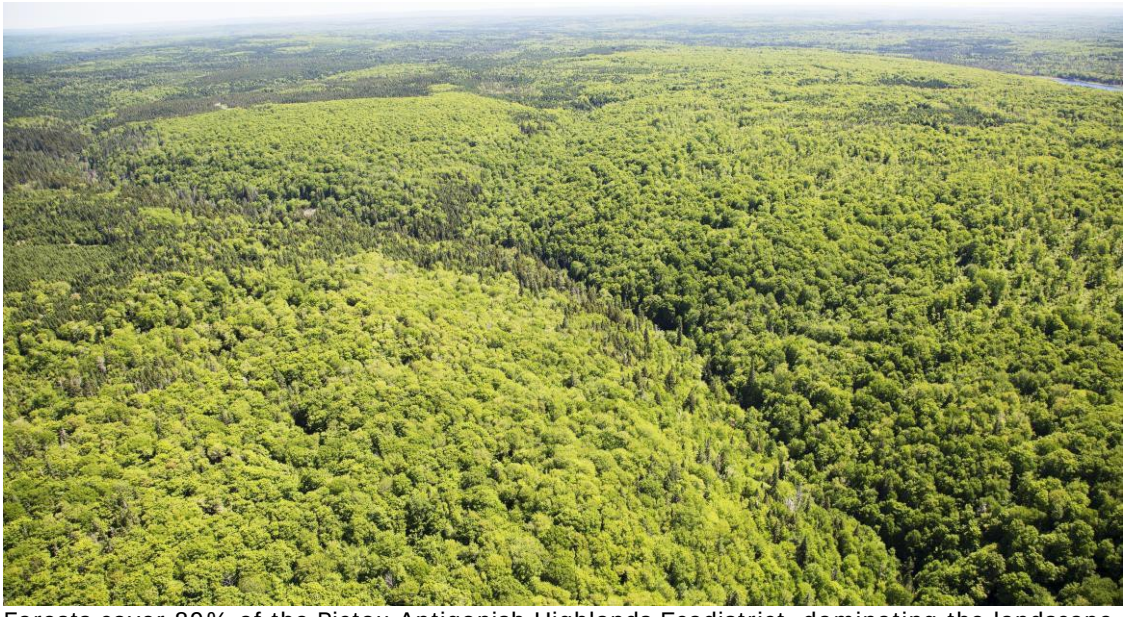
Within Pictou Antigonish Highlands, 89% of the land is forested. Table 3 shows the land category distribution.

Twenty-four percent of the ecodistrict is owned by the Crown. This Crown land is primarily forested land.

In the past, StoraEnso Port Hawkesbury Ltd. has held a license and management agreement with the province in which the company acted as the province's forest management contractor for the majority of the Crown lands. *The former StoraEnso mill was purchased by a new buyer and re-opened in October 2012 as Port Hawkesbury Paper LP.*

**Table 3 – Area Distribution by Land Category for All Owners**

| Category | Hectares | Percent |
|---|---|---|
| Forested | 119,344 | 89.1 |
| Wetland | 3,164 | 2.4 |
| Agriculture | 4,031 | 3 |
| Barrens | 27 | <0.1 |
| Urban | 1,059 | 0.8 |
| Road, Trail, Utility | 1,056 | 0.8 |
| Other | 5,239 | 3.9 |
| **Total** | **133,920** | **100** |



Forests cover 89% of the Pictou Antigonish Highlands Ecodistrict, dominating the landscape.

The average Land Capability (LC) of forested land in this ecodistrict is estimated to be 5.9 cubic metres per hectare per year ($m^3$/ha/yr), based on the ratings in Table 4. The average forest LC for the province is 4.9 $m^3$/ha/yr.

Some areas are not suitable for trees. These non-forested areas consist mainly of rock outcrops and barren lands.

Approximately 90% of the ecodistrict area has an LC 5 or greater rating.

**Table 4 – Area of Forested Land by Land Capability Rating**

| Land Capability (LC) Rating ($m^3/ha/yr$)* | Hectares | Percent |
|---|---|---|
| 2 or less | 123 | 0.1 |
| 3 | 1,698 | 1.4 |
| 4 | 9,500 | 8.0 |
| 5 | 19,505 | 16.3 |
| 6 | 61,456 | 51.5 |
| 7 or more | 27,062 | 22.7 |
| **Total** | **119,344** | **100** |

*Based on growth potential for softwood species.

## Water Resources

Within the Pictou Antigonish Highlands Ecodistrict, the drainage pattern is generally dendritic – similar in appearance to the branching pattern of tree roots – but is heavily influenced by fault lines.

Approximately 80% of the ecodistrict area drains into the Northumberland Strait, including St. Georges Bay.

The remaining 20% in the southern part of the ecodistrict drains into the Atlantic Ocean through the eastern branches of the St. Marys River.

Fresh water accounts for less than 1% of the ecodistrict.

Pictou Antigonish Highlands contains the James River watershed, which is the designated water supply area for the Town of Antigonish. Drainage into the east branch of the East River contributes to the water supply for the Town of Stellarton.

The James River watershed, which supplies water to the town of Antigonish, is part of the Pictou Antigonish Highlands Ecodistrict.

Forbes Lake, which is the primary water supply for the town of New Glasgow, is a partially spring-fed lake that lies adjacent to Pictou Antigonish Highlands. It is likely that groundwater from the elevated Pictou Antigonish Highlands contributes to the springs that feed Forbes Lake.

Water is an important provincial resource that must be considered in the context of IRM in general and specifically within individual ecosystems.

The Environmental Goals and Economic Prosperity Act, which was enacted in early 2007, has committed the province to prepare a comprehensive water strategy. This strategy will include a high-level evaluation of water resources for the entire province. In addition, detailed water resource studies have been completed for approximately 40% of the province and are available from the Nova Scotia Department of Environment. It is anticipated that the ELA, and subsequent ELA documents, will be modified once water resource information is made available. *The water strategy can be found at* *http://www.novascotia.ca/nse/water.strategy/docs/WaterStrategy_Water.Resources.Management.Strategy.pdf*

## Minerals, Energy and Geology

The Pictou Antigonish Highlands Ecodistrict lies within the Avalon Terrane of the Canadian Appalachians. The ecodistrict is underlain mainly by volcanic and sedimentary rocks belonging to the Georgeville Group (late Precambrian) and the Arisaig Group (Silurian). Cambrian to Lower Ordovician sedimentary and volcanic sequences (Iron Brook and MacDonalds Brook groups) occur in the northern Antigonish Highlands.

Topographic variations within the highlands are largely controlled by geological structures, such as faults and folds. Narrow valleys have formed along some of the fault lines, particularly where softer strata have been down faulted, or where movement along the faults has intensely fractured and weakened the adjacent rock.

Intrusive rocks, particularly those close to tidewater, are potential sources of aggregate materials, such as sand and gravel, for local and export markets. A site near Georgeville was developed as a bedrock aggregate quarry in 1960. The original quarry and its crushing and docking facilities operated for a few years and then were abandoned. Five bedrock quarries are operating in the ecodistrict (two in the Georgeville area, two in the McLellans Brook area and one in the Browns Mountain area).

Diatomaceous earth – made up of tiny fossilized organisms with silica skeletons – is known to exist in several lakes within the ecodistrict. The occurrence at Brora Lake (near Barneys River) is large enough and of sufficient quality to warrant further exploration.

The sedimentary rocks of the Carboniferous Period are targets for oil, gas, and coal exploration, providing source and reservoir rocks for hydrocarbons. A petroleum agreement is in place for the eastern half of the ecodistrict. Oil shale occurs within the Late Devonian to Early Carboniferous rocks, north of Lakevale, near Back Settlement.

The geology of the highlands has attracted geoscientists for many years. One of North America's most continuously exposed sections of Silurian rock (400 to 450 million years old) can be found at Arisaig. The geology and fossils along these 4 kilometres of coastline have been studied by geologists from around the world for over 150 years.

Marine fossils found in the shales and fine grained sandstones of the Arisaig Group include crinoid, brachiopods, nautilods, trilobites, pelecypods, cephalopods, ostracods, and graptolites. These fossils are well preserved and have been significant in tracing the history of the Avalon Zone and relating it to other parts of eastern North America.

In the recent past, field camps for geology and engineering (civil and mining) students were held at Crystal Cliffs.

The southern and the northwestern boundaries of the ecodistrict closely follow the traces of two major faults, the Chedabucto and Hollow faults. Between these two major faults the area is dissected by numerous smaller faults. Faulting in the northern highlands trends northeast and in the southern highlands east.

A distinct surface feature – the Hollow Fault scarp – extends from Cape George to near New Glasgow. The valley, called the "The Hollow" or "Bruin's Highway," has eroded from the softer or broken strata within the fault zone. From Malignant Cove to Cape George, the Hollow Fault forms high cliffs along the coastline. Except for the youngest Upper Carboniferous rocks, all the older sedimentary and volcanic units are folded to varying degrees.

The surficial geology of the Pictou Antigonish Highlands Ecodistrict consists predominantly of stony glacial till, generally less than five metres thick. Around the perimeter of the highlands a silty and sand till, three to 20 metres thick, is common. Unsorted sand and gravel deposits are found in kame terraces along the sides of several major stream valleys including Barneys River.

Alluvial and glaciofluvial deposits, with sand and gravel potential, occur in several of the ecodistrict's valleys (e.g. Moose River, Garden of Eden and Barneys River) and along the southern and eastern boundaries of the ecodistrict. Unconsolidated granular aggregate resources are extracted at a number of locations to supply the requirements of the local construction industry.

Colluvial deposits, along steep slopes, are common in the north and central area of the highlands. Scattered across the ecodistrict are significant areas dominated by weathered bedrock and rolling to rugged exposed bedrock, overlain by a discontinuous veneer of till. Surficial deposits make a major contribution to soil development and may be a source of aggregate. Scattered across the ecodistrict are small organic deposits of sphagnum moss and peat.

The variety of rock types, ages, and tectonic history of the highlands presents many possible environments for the formation of economic mineral deposits. A number of metallic mineral showings (e.g. copper, lead, zinc, gold, silver, and iron) occur within the ecodistrict. Mineral exploration dates back to the late 1800s.

Shafts and adits were driven on the more promising showings (there are approximately 70 documented abandoned mine openings; undocumented abandoned mine openings may exist). The Arisaig Iron District occurs in the Arisaig and Malignant Cove area, between MacKinnons Brook and Arisaig Brook. The iron deposit was explored by numerous pits and shafts (there are approximately 50 documented abandoned mine openings), trenches, and boreholes.

The thickness of the iron beds is variable and the deposit is cut by numerous small faults. In 1893 a trial shipment of 1,376 tonnes of iron ore was sent to the blast furnaces at Ferrona in Pictou County.

The Georgeville base metal deposit (low grade zinc, minor copper, and lead) on the west side of the Cape George peninsula has been actively explored since 1953. Interest in the Georgeville deposit is largely based on the five-kilometre-long strike length of the mineralized zone. Two silver exploration shafts were sunk in the Malignant Cove to Georgeville area.

Exploration shafts were sunk on several copper showings, including the College Grant copper deposit (west of Lochaber Lake). Unexplored mineral occurrences and deposits may exist within the Ecodistrict. Currently there are no active mines in the Pictou Antigonish Highlands Ecodistrict.

Potential geohazards, such as abandoned mine openings, potential karst areas, flood risk areas, sulphide-bearing slates, and underground coal workings, can be viewed at the following web sites:
http://gis4.natr.gov.ns.ca/website/nsgeomap/viewer.htm
http://gis4.natr.gov.ns.ca/website/mrlu83/viewer.htm
Please report any additional geohazards found on Crown lands to your nearest Natural Resources office.

## Parks and Recreation / Protected Areas

The Pictou Antigonish Highlands Ecodistrict includes provincial parks and protected areas that total approximately 5,760 hectares.

The Eigg Mountain – James River Wilderness Area accounts for 5,490 hectares. Of this, 4,150 is the wilderness area and the remaining 1,340 hectares is owned by the town of Antigonish as part of the James River protected water area, most of which is within the wilderness area. (Note: At the time GIS statistics were generated for this report, the Eigg Mountain – James River Wilderness area was not entered into the GIS database.)

Among the provincial parks and park reserves in the ecodistrict are:

**Beaver Mountain Park** – This 133-hectare operational day use park is designated under the Parks Act and is jointly operated by DNR and the Municipality of Antigonish County. This park contains hiking and cross country ski trails, including a paved loop which provides easy access through an old field white spruce stand.

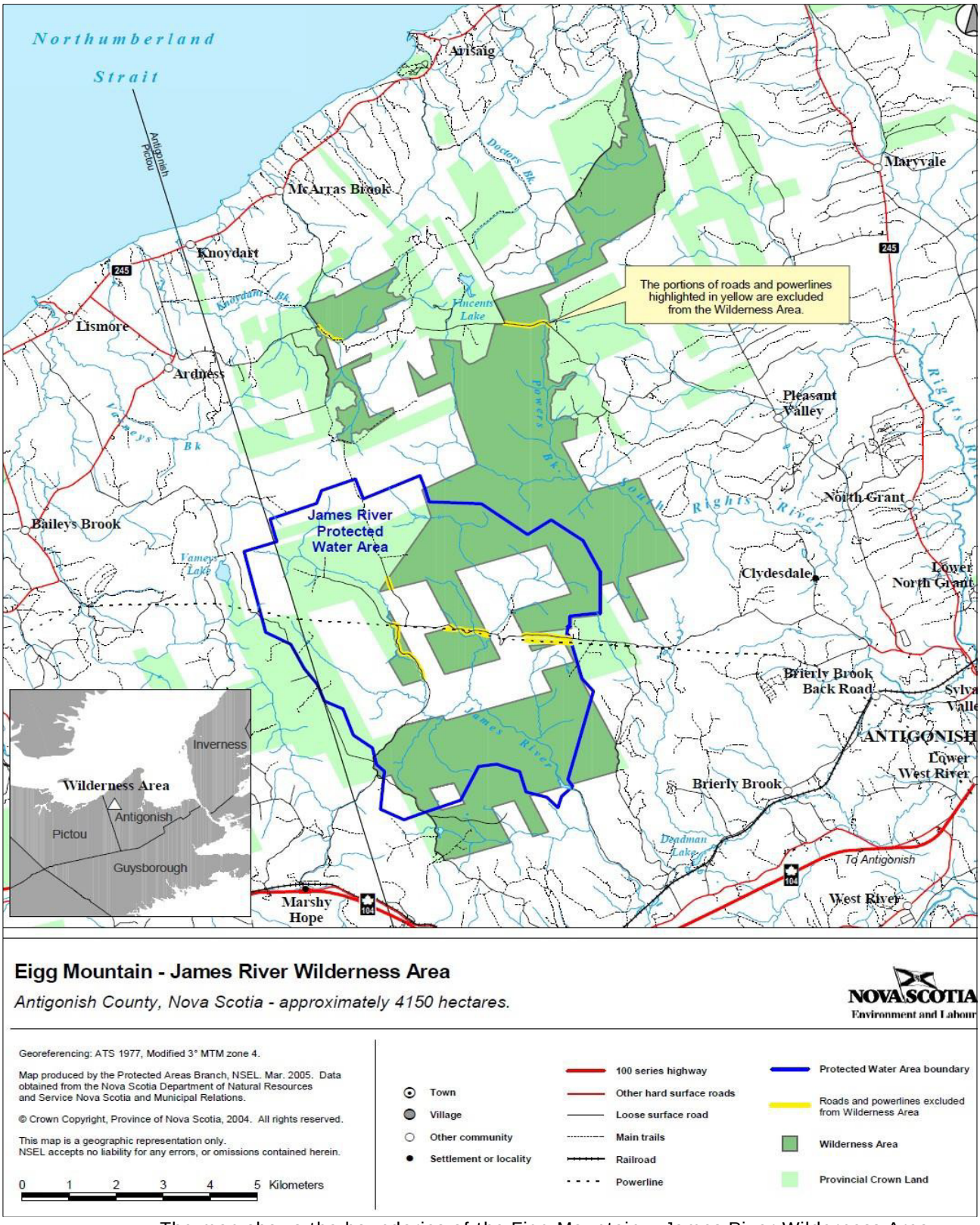
Beaver Mountain Park offers hiking and cross country ski trails in the Pictou Antigonish Highlands Ecodistrict.

**Arisaig Provincial Park** – This designated operational day use park contains 30 hectares of coastal land. In addition to providing shoreline access, this park has trails and interpretive panels. The park and is best known for the abundance of fossils more than 400 million years old found in an eroding coastal cliff.

**Cape George Park Reserve** – This property is located at Cape George Point and contains recently acquired land around the federally owned lighthouse property. A portion of this land is leased by the local communities for a day use park. This property also offers significant views of St. Georges Bay.

**James River Park Reserve** – This is the former site of a provincial day use park and straddles the Trans-Canada Highway at James River. No services or facilities are currently provided at this site.

Along the coastal boundaries of this ecodistrict, three beaches are designated under the Beaches Act. These beaches are located at Malignant Cove, Livingstone Cove, and Ballantynes Cove. With the exception of 1 hectare of Crown land at Malignant Cove, all of the upland areas within these designations are on private land.




The map shows the boundaries of the Eigg Mountain – James River Wilderness Area and the James River protected watershed.

Pictou Antigonish Highlands provides opportunities for traditional outdoor recreational activities, including fishing, hunting, hiking, and biking and off-highway vehicle use. Snowmobile clubs in Antigonish and Pictou counties maintain a series of groomed trails that are a part of the provincial network established under the auspices of the Snowmobilers Association of Nova Scotia (SANS).

The relatively higher elevation of this ecodistrict provides for locally significant scenic travel routes, such as the "Mini Trail" around Cape George on Highway 337.

The most current and up-to-date information for parks and protected areas in this ecodistrict can be found at: http://novascotia.ca/parksandprotectedareas/plan/interactive-map/.

## Wildlife and Wildlife Habitat

Wildlife in the Pictou Antigonish Highlands Ecodistrict includes relatively common species of plants, animals, and other organisms, along with some species that are rare and/or at risk in Nova Scotia.

Wildlife information for Pictou Antigonish Highlands and other ecodistricts comes from a number of sources, including surveys, harvest statistics, hunter and trapper reports (abundance rankings), biological collections from harvested and road killed animals, and observations and reports from the public and DNR staff. Information on important sites is documented by DNR in the Significant Habitats Database and by the Atlantic Canada Conservation Data Centre in Sackville, N.B.

Old forests are recognized as providing important wildlife habitat. The provincial goal is to have a minimum 8% for old forests on Provincial Crown land. Shade-tolerant hardwoods and softwoods may provide important wildlife structural components, such as cavity trees, and are encouraged across the landscape through appropriate silviculture systems.

Habitat suitable for large mammals can be found throughout the ecodistrict.

Black bear and white-tailed deer populations are healthy. Black bear are particularly prevalent along the Northumberland shore.

Endangered mainland moose live at higher elevations where regenerating forests stands can be found near suitable cover and water. Habitat needs for moose vary throughout the province, but moose generally require a variety of successional conditions to satisfy various life stages and needs. The Pictou Antigonish Highlands Ecodistrict is found within one of the province's mainland moose concentration areas.

All moose require adequate food supplies and protection from summer heat in the form of thermal cover. Suitable foraging areas are often found in areas disturbed by fire, wind, insect outbreaks, and forest management. Thermal cover is provided with stands of mature softwood and hardwood.

The Forest / Wildlife Guidelines and Standards for Nova Scotia provide for basic habitat needs for moose through the retention of old growth forest, protection of wetland habitats, watercourses with riparian buffers, and forest management strategies that promote a balanced distribution of forest

seral stages. Additional habitat requirements for mainland moose are being addressed by the Mainland Moose Recovery Team and involve special management practices for forestry.

Current and potential old growth forest habitat has been identified for this ecodistrict. This habitat will benefit a variety of wild species, including moose, interior forest species that cannot tolerate forest fragmentation, and cavity nesters, such as some of the song birds and owls.

Winter surveys for owls in 2006 indicated a relatively large population of barred owls in this ecodistrict. Lakes and open water wetlands are relatively uncommon in this ecodistrict, but those that can be found often have breeding loons.

There are several deer wintering areas in this ecodistrict. In years when snow depths force deer off higher elevations, the deer congregate in lowland wintering areas in December and remain there until mid-March.

Wintering areas are generally characterized by the presence of mature softwood stands near water and a food source, on south or southwest slopes.

White spruce and balsam fir are the dominant softwood species in nearly all deer wintering areas in this ecodistrict. Several wintering areas are in decline because of the age of the softwood and increased presence of bark beetle that damages and eventually kills white spruce. Bark beetle is especially common in mature softwood stands along the Northumberland shore.

Several bald eagle nests are located in this ecodistrict, as well as nests of the northern goshawk. Goshawks require largely undisturbed tolerant mixedwood areas for successful breeding.

There is no evidence at this time of Bicknell's thrush occurring in this ecodistrict, although suitable habitat likely occurs.

The ecodistrict contains the headwaters of several rivers which have runs of salmon, trout and other fish. This emphasizes the need for special management zones along watercourses to protect aquatic habitats.

Other notable semi-terrestrial species include wood turtles that are found in watercourses that bound the ecodistrict to the south and east such as the east and north branches of the St. Marys River. These same watercourses provide habitat for several species of freshwater mussels.

*For more detailed and more current information on species at risk and species of conservation concern in this ecodistrict, refer to Appendix 3 and Map 6 in a separate Part 3 of this document.*

*These species are important components of the landscape and are given priority attention in planning, management, and stewardship activities.*

With much of the ecodistrict privately owned, effective wildlife management will to a great extent rely on active, informed stewardship by the many landowners. The DNR can assist private land stewardship by providing knowledge and information on various management strategies. Legislation such as the Wildlife Habitat and Watercourse Protection Regulations, the Endangered Species Act, and the Environment Act's Activities Designation Regulations address species and habitat concerns within the forest and wetland ecosystems.

Several wintering areas for white-tailed deer are found in the ecodistrict.

# Part 2: Linking the Landscape to the Woodlot – *How Woodland Owners Can Apply Landscape Concepts to Their Woodland*

This second part of the report provides information on how landscape concepts can be applied at the woodlot level. The starting point is an introduction to natural disturbances and succession to provide a foundation for better understanding forest ecosystems. The focus then shifts to elements that make up each ecodistrict and the forest groups and vegetation types at the stand level. This allows woodland owners to move between elements and stands to see how their woodland fits in with the larger landscape.

## Forest Disturbances and Succession

### Forest Disturbances

A disturbance can be described as an event, either natural or human-induced, that causes a change in the existing condition of an ecological system.

Disturbance pattern controls forest development classes (establishment, young, mature, multi-aged / old forest) and their distribution over area and time.

Due to the coastal location of Nova Scotia and its Maritime climate, the extent, intensity, and frequency of natural disturbances is difficult, for the most part, to predict. Prior to European settlement, natural disturbances were only curtailed by natural barriers such as water, climate, topography, and vegetation change. After about 400 years of activity by European settlers, the frequency, intensity, and magnitude of these natural processes has been affected.

New disturbances have been introduced as a result of human activity and include:

- clearing of forests for agriculture
- timber harvesting
- urbanization and development
- introduction of exotic animals, plants, and insects
- disease-causing agents, such as viruses or bacteria
- fire suppression in the forest
- changes in the chemical and physical characteristics of the atmosphere

Understanding how ecosystems respond to disturbances is critical to understanding how they function and how they can be managed. This will assist woodland owners and forest managers in:

i. assessing the potential for old forest stands and development class distributions
ii. determining appropriate patch sizes and species composition to emulate natural structures and processes
iii. prescribing the appropriate rotation age and development class structure across a forested landscape

iv. projecting future changes to the forest due to climate change and human disturbances
v. maintaining and conserving biodiversity

Natural disturbances are agents that abruptly change existing conditions and initiate secondary succession to create new ecological communities.

By adapting forest management practices to create the structures and processes that emulate natural disturbances, woodland owners and forest managers can help shape forest landscapes.

One approach that closely mimics nature is to allow ecosystems to naturally develop without active management. This approach is particularly effective on lands with long-lived tree species, such as red spruce, white pine, hemlock, sugar maple, yellow birch, and beech. One of the roles of protected areas is to allow this to occur and also provide a model to compare with managed forests.

## Natural Succession

Succession refers to the changes in vegetation types (communities) following disturbance which, over time, often leads to a climax stage. Most changes follow a course of vegetation community development (seral stages) for a particular disturbance regime.

Climax vegetation refers to vegetation communities that are relatively long-lasting and self-replacing. Three types of climax vegetation can be described as follows:

**Climatic climax** – Vegetation types that are mainly a function of regional climate conditions; these occur on sites with average (mesic) moisture and nutrient conditions.

**Disturbance climax** – Vegetation types which, due to frequency of disturbance, do not progress to the climatic climax.

**Edaphic climax** – Vegetation types that are mainly a function of soil and site conditions (i.e. low or excess moisture, low or high fertility) which do not progress to the climatic climax.

### Another Definition of Succession

Succession, as defined by Odum (1971), is an orderly process of community development that involves changes in species structure and community processes with time; it is reasonably directional and, therefore, predictable.

Successional development generally proceeds through a number of distinct seral stages (e.g. early, middle, late) that replace one another in a predictable sequence and which culminates in a relatively stable and self-perpetuating community condition called a climax.

– From *Part 1: Vegetation Types (2010) of Forest Ecosystem Classification for Nova Scotia*
*http://www.gov.ns.ca/natr/forestry/veg-types*

## Pictou Antigonish Highlands – Elements Defined

Landscapes are large areas that function as ecological systems and respond to a variety of influences. Landscapes are composed of smaller ecosystems, known as elements. These elements are described by their physical (e.g. soil, landform) and ecological features (e.g. climax forest type). These characteristics help determine vegetation development. Elements promote an understanding of historical vegetation patterns and present disturbances.

A landscape profile identified and mapped seven distinctive elements in the Pictou Antigonish Highlands Ecodistrict – one matrix, five patches, and a corridor (Table 5a). A matrix is the dominant community type. Patches are smaller yet still distinctive community types. Corridors are natural linear communities, such as river valleys, that link parts of the ecodistrict.

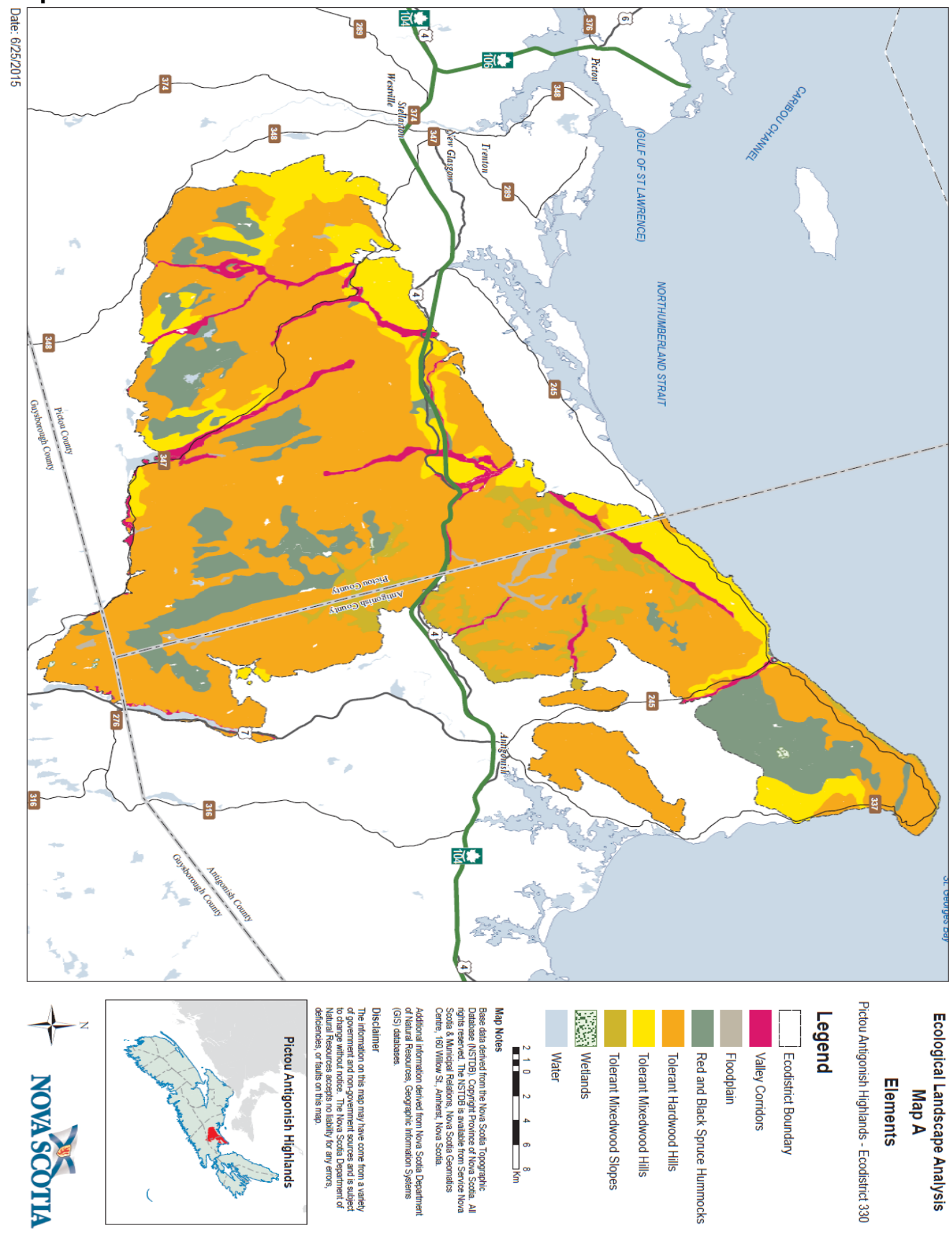
**Tolerant Hardwood Hills** is the matrix element, representing 64% of the ecodistrict. This element represents shade-tolerant hardwoods, such as sugar maple, yellow birch, and beech, typical of the Acadian Forest. This type of forest can be seen on the slopes along the Trans-Canada Highway in the Marshy Hope area.

**Red and Black Spruce Hummocks** is the largest patch element, generally found on the plateau-like top of the ecodistrict. Red spruce is usually found on well-drained soils while black spruce is more likely found on soils that are wetter.

The other patch elements, in order of size, are **Tolerant Mixedwood Hills**, **Tolerant Mixedwood Slopes**, and **Floodplain.** *A tiny Wetlands element is also part of the ecodistrict.*

**Valley Corridors** is a linear corridor element associated with the major watercourses in the ecodistrict.

## Map of Elements in Ecodistrict



## Forest Stands Within Elements

Each element contains a number of forest stands that can be classified by vegetation, soil, and ecosites. The DNR publication ***Forest Ecosystem Classification for Nova Scotia, Part I: Vegetation Types (2010)*** (http://novascotia.ca/natr/forestry/veg-types/veg-navigation.asp) is helpful in identifying forest plant communities.

Viewed online or available in print through DNR, woodland owners can learn about the characteristics of a particular forest community. Refer to Table 5a for descriptions of elements and Table 5b for forest vegetation types that are likely to be found within elements.

Shade-tolerant hardwoods, along with red and black spruce, are the main tree species in the Pictou Antigonish Highlands Ecodistrict.

| Table 5a – Elements Within Pictou Antigonish Highlands | | |
|---|---|---|
| **Element** | **Size (Hectares)** | **Element Description** |
| Tolerant Hardwood Hills (Matrix) | 84,863<br>63.7% | The slopes of the Pictou Antigonish Highlands support the shade-tolerant hardwood matrix element of the ecodistrict and are typified by the forests on the slopes along the Trans-Canada Highway through Marshy Hope. This element represents mid to late successional tolerant hardwood forests typical of the Acadian Forest. Representative species include sugar maple, beech, and yellow birch, with white ash and ironwood on the richer sites. This element occurs primarily on slopes and hummocky terrain of the uplands. Soils are well-drained loams and sandy loams of medium to rich fertility. Vernal pools (ephemeral water collection areas) and seepage areas are important biodiversity features commonly found in this tolerant hardwood forest. Under these closed canopy forests, the shrub layer consists of regenerating trees and shrubs such as hobblebush, fly honeysuckle, and beaked hazelnut. These forests also have an abundant cover of ferns and club mosses. Natural stand-level disturbances are rare and stands will usually maintain themselves through gap replacement leading to uneven-aged climax forests. Stands can develop old forest characteristics. Natural disturbance agents include hurricanes, ice storms, disease and insects. |
| Red and Black Spruce Hummocks (Patch) | 19,291<br>14.5% | Red and black spruce occurring on imperfectly drained soils create a mid-sized landscape patch element on hummocky terrain on the plateau-like top of the ecodistrict. The occurrence of the two spruce species is dictated by soil drainage. Red spruce will occur on well-drained and moderately well-drained soils. Black spruce will be found on the imperfectly to poorly drained soils. The hybridized red and black spruce will occur wherever soils are not quite fertile enough to support red spruce. This element represents mid to late successional forests with red spruce stands more typical of the Acadian Forest. Embedded within this element on crests and longer upper slopes with richer and better-drained soils tolerant hardwoods will occur. Natural stand-level disturbances are frequent in the spruce forests with hurricanes, fire, and insects the most probable agents. Clearcut harvesting will increase pioneer species competition levels with species such as raspberry and pin cherry. |
| Tolerant Mixedwood Hills (Patch) | 17,335<br>13% | This large patch element occurs on hilly terrain generally located on the periphery of the ecodistrict. Significant area is found around Cape George, Kirkmount to Telford, and Garden of Eden to Kerrowgare. The soils are well to imperfectly drained, fine-textured sandy clay loams and clay loams and support a late successional forest dominated by the shade-tolerant species of the Acadian Forest. On the upper slopes and crests, forests comprise sugar maple, yellow birch, and beech, but at the middle and lower slope positions forests tend to comprise red spruce and balsam fir mixed with yellow birch and maple. At toe slope positions, soils are often moister and richer as both moisture and nutrients move downslope to reach the watercourse and/or level terrain associated with riparian zones. Here and on seepage sites associated with breaks in the slope, trees such as white ash and ironwood will be found to indicate improved condition. |

| Table 5a – Elements Within Pictou Antigonish Highlands | | |
|---|---|---|
| **Element** | **Size (Hectares)** | **Element Description** |
| Tolerant Mixedwood Slopes (Patch) | 5,770<br>4.3% | The steep slopes of ravines and gorges in Pictou Antigonish Highlands support a mixedwood forest of shade-tolerant species such as red spruce, hemlock, yellow birch, beech, and sugar maple. This linear patch level element is typical along several rivers and brooks, including the James River, South Rights River, Rights River, Donny Brook, and Brierly Brook. The steep slopes of the Hollow Fault support this element as well as the Northumberland Strait-facing cliffs of Cape George where white spruce is more prominent in the forest. Soils are rapid to well-drained loams and sandy loams and generally of medium fertility. At lower slope positions the component of hemlock in the forest often increases to become the dominant species. Earlier and mid-successional stages can be dominated by intolerant hardwood species, such as red maple and white birch while balsam fir can be abundant in young softwood forests. |
| Floodplain (Patch) | 884<br>0.7% | The Floodplain element in this ecodistrict is associated with smooth, level terrain along the larger streams. Soils are primarily derived from glacial fluvial outwash and are gravelly loamy sands and sandy loams. These conditions are found along the larger rivers and streams, including the James and Moose rivers. Where alluvial deposits of sediment occur along Barneys River and Donny Brook, with annual or periodic flooding, soils are less gravelly and include sandy loams and loams. These are linear, small patch-level elements supporting a variety of forest types. The climax forest for this element is the typical sugar maple, white ash, and elm community. |
| *Wetlands (Patch)* | *116*<br>*0.1%* | *The Wetlands element is a patch ecosystem comprising freshwater bogs, fens, swamps, and poorly drained areas. The element may occur as a large wetland complex associated with rivers and lakes, as narrow linear communities associated with flow accumulations and small streams, as a community of hydrophytic vegetation (sedges, sphagnum moss, false holly, and winterberry) associated with level terrain where drainage is impeded or as a depression in the landscape where water remains in excess year round. A significant wetland is associated with the Moose and Garden rivers where they enter the Garden of Eden. Another important wetland associated with a concentration of small streams and level terrain is Heffernans Marsh on Cape George.* |
| Valley Corridors (Corridor) | 4,977 ha<br>3.7% | The most evident linear features within this ecodistrict are faults and folds and associated watercourses. Lochaber, Barneys River, Garden of Eden, Marshy Hope, and Malignant Cove corridors have significant levels of land use which have created settlements, agricultural fields, power lines, highways, other roads, and railways. A significant man-made feature on the James River corridor is the reservoir dam. These land use changes reduce the connective function of the corridor for some species and may also increase the barrier effect of the corridors for species that must move across or through them. |
| **Total** | **133,236*** | *Area is not the same as in Table 1 because water has not been included. |

**Table 5b – Forest Vegetation Types[1] Within Elements in Pictou Antigonish Highlands**

| Element | Seral Stage | | | | | |
|---|---|---|---|---|---|---|
| | Early | % * | Middle | % | Late | % |
| Tolerant Hardwood Hills | IH3, IH4, IH5, IH6, MW4, MW5, OF1, OF2, OF4, OF5 | 30 | IH7, SH10, TH6, TH7, TH8 | 17 | **TH1, TH2,** TH3, TH4, TH5 | 34 |
| Tolerant Mixedwood Hills | IH3, IH4, IH6, MW4, MW5, OF1, OF2, OF4, OF5 | 30 | IH7, MW2, SH5, SH6, SH7, SH8, SH10, TH7, TH8 | 17 | **MW1, MW3,** SH1, TH1, TH2, TH3, TH4 | 34 |
| Tolerant Mixedwood Slopes | IH3, IH4, IH6, MW4, MW5, OW3, OW6 | 21 | IH7, MW2, SH5, SH6, SH7, SH8, SH10, TH7, TH8 | 23 | **MW1, MW3,** SH1, TH1, TH2 | 48 |
| Red and Black Spruce Hummocks | IH1, IH3, IH4, IH6, MW4, MW5, SP6 | 30 | MW2, SH5, SH6, SH7, SH8 | 21 | **SH1, SH2, SH3,** SP5, SP7 | 30 |
| Floodplain | OF1, OF2 | 38 | FP6 | 34 | **FP1** | 24 |
| *Wetlands* | *WC1, WC2, WC5, WC6, WD1, WD2, WD3, WD6, WD7, WD8, SP7* | | | | | |

View forest groups and vegetation types at http://novascotia.ca/natr/forestry/veg-types/veg-navigation.asp

To help with identification of vegetation types, the 14 forest groups in Nova Scotia designated by DNR are: Cedar (CE), Coastal (CO), Flood Plain (FP), Highland (HL), Intolerant Hardwood (IH), Karst (KA), Mixedwood (MW), Old Field (OF), Open Woodland (OW), Spruce Hemlock (SH), Spruce Pine (SP), Tolerant Hardwood (TH), Wet Coniferous (WC), Wet Deciduous (WD)

**Bolded vegetation types** indicate typical late successional community

[1] Forest Ecosystem Classification for Nova Scotia (2010)

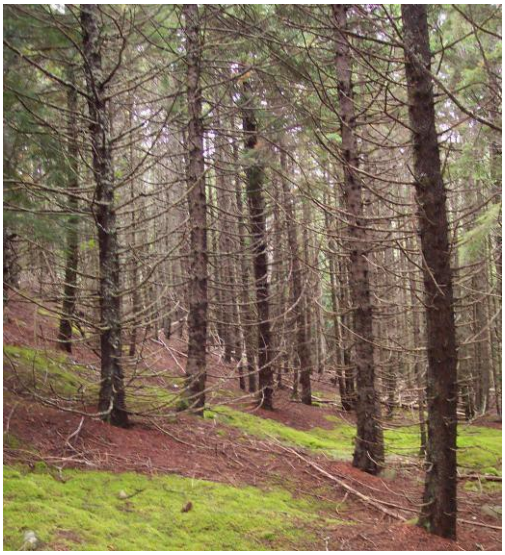
*Percentage of element in each successional stage. Percentages may not total 100 due to unclassified lands (such as clearcuts and regenerating stands) not being included.

## Photos Illustrating Vegetation Types in Elements

The following photos show some of the vegetation types expected to be found within their respective elements.

Sugar maple / Hay-scented fern (TH1) is a late successional vegetation type found in the Tolerant Hardwood Hills matrix element.

Hemlock / Pin cushion moss / Needle carpet (SH1) is a late successional vegetation type found in the Red and Black Spruce Hummocks patch element.



White spruce / Aster – Goldenrod / Shaggy moss (OF1) is an early successional vegetation type found in the Tolerant Mixedwood Hills element.

White spruce – Balsam fir / Broom moss (SH10) is a mid-successional vegetation type found in the Tolerant Mixedwood Slopes element.

Sugar maple – White ash / Ostrich fern – Wood goldenrod (FP1) is a late successional vegetation type found in the Floodplain element.

Balsam fir – White ash / Cinnamon fern – New York fern / Sphagnum (WD7) is a vegetation type found in the Wetlands element.

## Landscape Composition and Objectives

Landscapes contribute to the maintenance and conservation of native biodiversity. Managing landscapes for biodiversity requires a variety of planning approaches and tools. Sustaining forest composition diversity by reflecting natural patterns of disturbance and succession is one approach that DNR is employing to try and realize this objective. DNR is developing a number of additional approaches and planning tools which will be integrated with objectives defined in the ELA protocol.

Human activities, such as forest harvesting, can have a significant impact on the structure and composition of the forested landscape. Well-planned harvesting can provide a tool to achieve landscape composition goals.

### Natural Disturbance Regimes

Three natural disturbance regimes dominate natural forests:

Frequent Stand Initiating – Disturbances usually occur more frequently than the average life span of the dominant species and are of sufficient intensity to kill most of the existing mature trees, thereby promoting the establishment of a new forest within a relatively short period. Some unharmed trees often survive the disturbance in pockets and/or as scattered individuals.

Infrequent Stand Initiating – The time between stand-initiating disturbances is usually longer than the average longevity of dominant species, thereby supporting processes of canopy gap formation and understory development in mature forests.

Gap Replacement – An absence of stand-initiating disturbances supports the development of a dominant overstory that is sustained through dynamic processes of canopy gap formation, understory development, and overstory recruitment. Gap formation ranges from individual tree mortality to the replacement of a small group of trees.

In the Pictou Antigonish Highland Ecodistrict, gap disturbance is the predominant natural process shaping the diversity of forest ecosystems. On its own, this type of disturbance regime generally leads to establishment and perpetuation of late successional vegetation types such as red spruce, hemlock, yellow birch, sugar maple, and beech.

On imperfectly drained areas within this ecodistrict, frequent stand-initiating disturbances dominate. These disturbances occur frequently enough so that there is a rapid mortality of an existing stand and quick establishment of a new stand of relatively even age. Black spruce and lesser amounts of red spruce tend to be the dominate species on such sites in Pictou Antigonish Highlands.

The occurrence of fire in this ecodistrict is likely to be most often associated with frequent stand-initiating sites.

## Forest Composition

Forest disturbances lead to forest renewal and the development of young forest habitats with characteristic successional patterns. Management of landscapes to conserve biodiversity requires sustaining ecologically adequate representation of natural habitat diversity, among a number of other measures and planning approaches.

At a landscape planning scale, the variety of habitats can be broadly described in terms of the composition of development classes, seral stages, and covertypes.

**Development Classes** describe changes in structure and process as forests age and trees grow larger. For landscape management purposes, four development classes are recognized:

- forest establishment (0 to 6 m height)
- young competing forest (7 to 11 m height)
- mature forest (> 11 m height; including multi-aged and old forest)
- multi-aged / old forest (multiple layered)

Within this simplified description there is considerable variation in the processes and structures that evolve in particular stands. When the current forest inventory is used to classify development classes, the height criterion is used. When forecasting future conditions using the Forest Model, the age criterion is preferred.

Harvesting and silviculture activities, such as planting and thinning, have been ongoing on Crown land since the 1940s.

**Seral Stages** describe changes in species composition of forest communities as succession progresses from domination of early seral "pioneer" species following disturbance, toward late seral communities dominated by long-lived, shade-tolerant "climax" species. Seral stage is dependent on the composition of tree species of a forest, irrespective of age. For landscape management purposes, three seral stages are recognized:

- early
- mid
- late

Early successional species are those that do well in direct sunlight and include white and grey birch, aspen, poplar, white spruce, tamarack, pin cherry, jack pine, and red pine. These species grow quickly, but are usually short-lived.

They are replaced by mid-successional species that can tolerate moderate amounts of shade, such as white ash and red oak.

Late successional species generally have a high shade tolerance and include hemlock, red spruce, sugar maple, and beech, as well as yellow birch and white pine. The species often develop slowly in shaded understories and can be long-lived and form old growth.

**Covertypes** descriptions further refine landscape composition by distinguishing forests of different community conditions. Management generally recognizes three forest covertypes:

- softwood (overstory cover of softwood species is 75% or more)
- hardwood (overstory cover of hardwood species is 75% or more)
- mixedwood (overstory cover of either softwood or hardwood is between 25% and 75%)

## Forest Composition Objectives

Within ecodistricts, the forest composition should contain a range of conditions that sustain the inherent forest communities and dominant natural disturbance regimes. Table 6 provides target ranges for development class and seral stage composition appropriate for different disturbance regimes. These ranges have been derived from the professional judgment of DNR forest ecologists to guide composition objectives for large landscape areas.

Woodland owners can use this guidance to assess how their holdings contribute to the overall ecodistrict structure by referring to the landscape element bar charts that illustrate where deficiencies exist. For example, landowners who have a large amount of mature forest in an element where this is in short supply can recognize the contribution of their holdings to the overall health of the landscape.

Four hundred years of European settlement in the Acadian region has left insufficient natural landscape structure to confirm these ranges. Facing similar challenges, a comprehensive modeling approach was used by the Ontario Ministry of Natural Resources to support "range of variation" targets for natural disturbance regimes in the Great Lakes St. Lawrence region (http://www.ontario.ca/document/forest-management-great-lakes-and-st-lawrence-landscapes).

A full description of definitions and mapping of Nova Scotia's disturbance regimes is contained in the report "Mapping Nova Scotia's Natural Disturbance Regimes" available from the DNR website (http://novascotia.ca/natr/library/forestry/reports/NDRreport3.pdf).

**Table 6 - Landscape Composition Target Ranges (by Development Class / Disturbance Regime)**

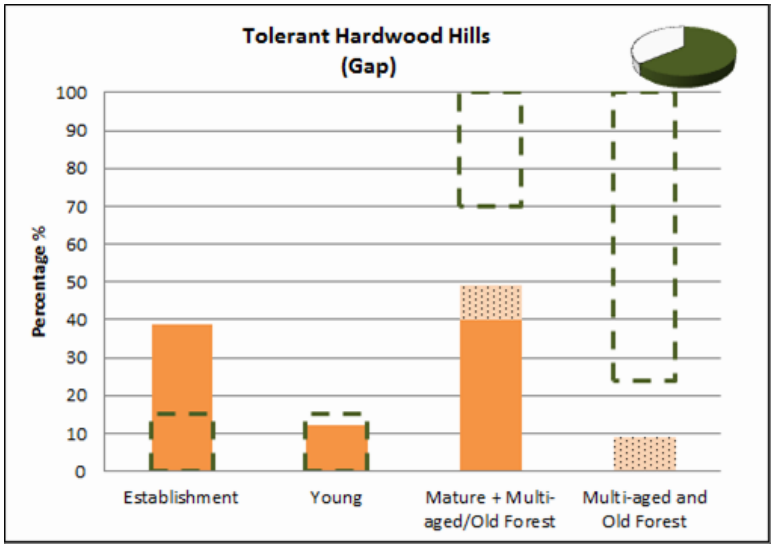
| Natural Disturbance Regime | Development Class | | | |
|---|---|---|---|---|
| | Forest Establishment | Young Competing Forest | Mature Forest (including multi-aged and old forest) | Multi-aged and Old Forest |
| Frequent Stand Initiating | 5 - 30% | 5 - 30% | >40%<br>early, mid, and late seral representation | >8% |
| Infrequent Stand Initiating | 5 - 20% | 5 - 20% | >60%<br>most in mid and late seral stages | >16% |
| Gap Replacement | 0 - 15% | 0 - 15% | >70%<br>most in late seral stage | >24% |

Table 6 indicates that for frequent stand-initiating disturbances, both establishment and young development class forests would typically comprise between 5 and 30% of area, while mature forest – which includes multi-aged and old forest – would cover more than 40%. Mature forest should consist of a relatively even balance of early, mid, and late successional stands. At least 8% of the mature forest should be in the multi-aged and old forest class. The targets for the other disturbance regimes are shown in Table 6. Forest planning should strive to maintain composition within these targets, and identify corrective and mitigating measures when outside these ranges.

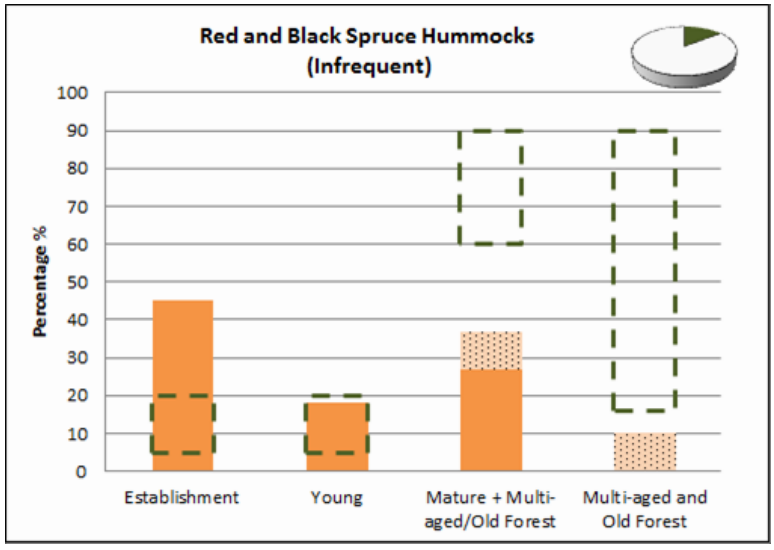
## Development Class Targets by Element

The series of charts that follow combine data on development classes for each element with desired or target percentages, based on the type of natural disturbance regime. The target percentages (from Table 6) are represented by rectangles of broken green lines. The light brown bars show the percentage of each development class at the time the original data was gathered. The dotted area in the mature class shows the amount of multi-aged and old forest area included. The coloured portion of the small pie chart in the corner of the graphic shows the relative size of the element within the ecodistrict.

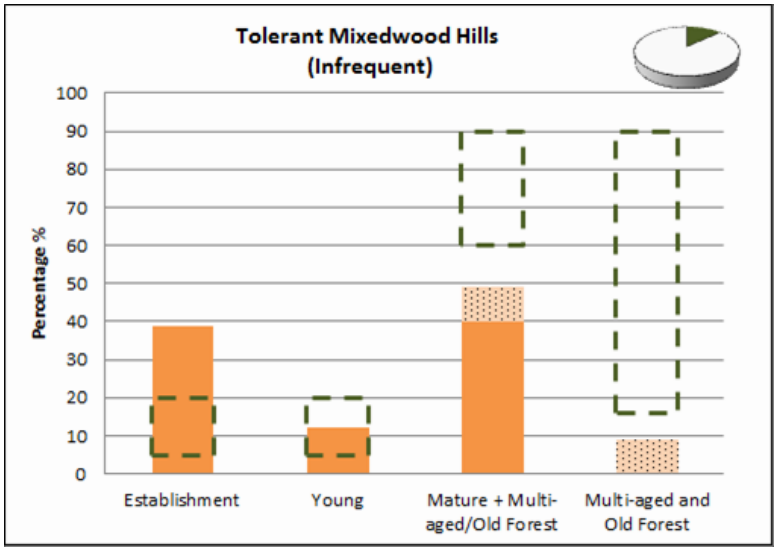
In the matrix element **Tolerant Hardwood Hills,** mature and old forest has been significantly reduced below target levels and replaced with younger establishing forests. Continuing harvest of mature forests can use partial harvesting techniques consistent with gap disturbance ecology to maintain mature forest conditions and promote multi-aged forests. Prescriptions that increase late successional species in young forests should be used.



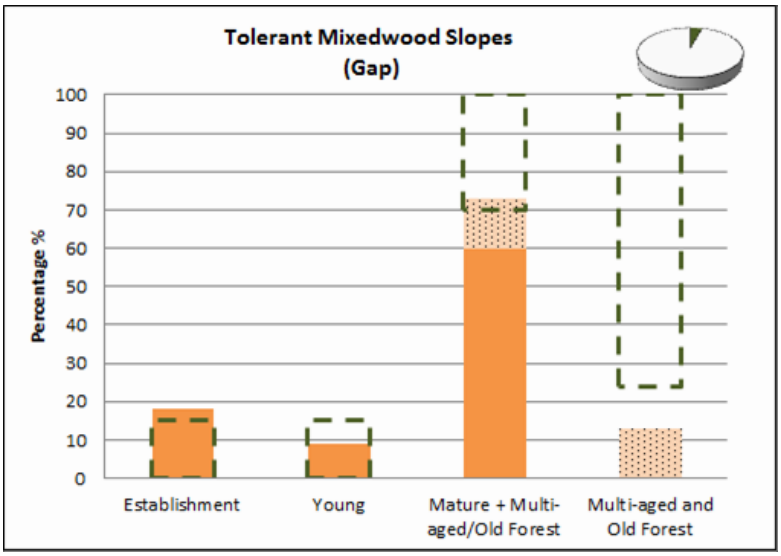

Development classes in **Red and Black Spruce Hummocks** for mature and old forest are significantly below target levels and are replaced with younger establishing forests. The red spruce component of this element can provide opportunities to maintain and restore forest using extended rotations and uneven-aged practices to favour climax species. Thinning can be used to enhance late successional species composition and increase growth rates.



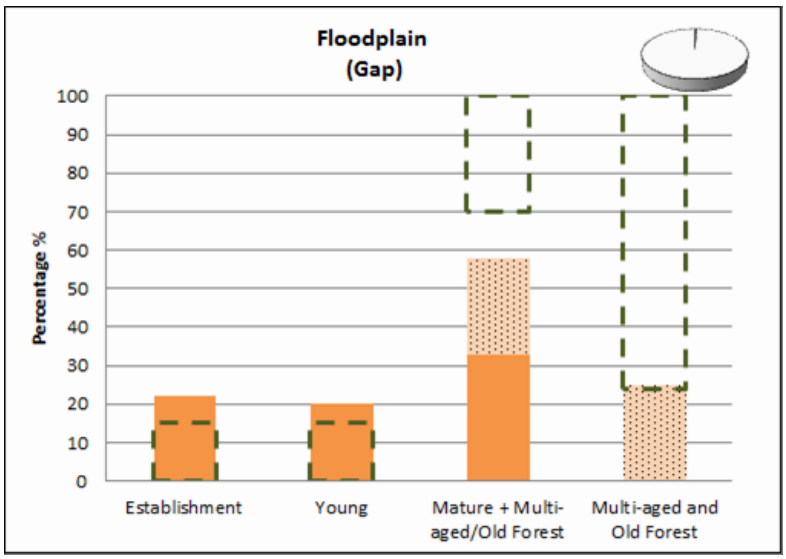
In **Tolerant Mixedwood Hills,** mature and old forest has been significantly reduced below target levels and replaced with younger establishing forests. Extended rotations and partial harvesting to favour climax species and retain large old trees will promote multi-aged forests and maintain mature conditions. With the establishment class at double the desired condition, forestry prescriptions that increase late successional species in young forests should be used.



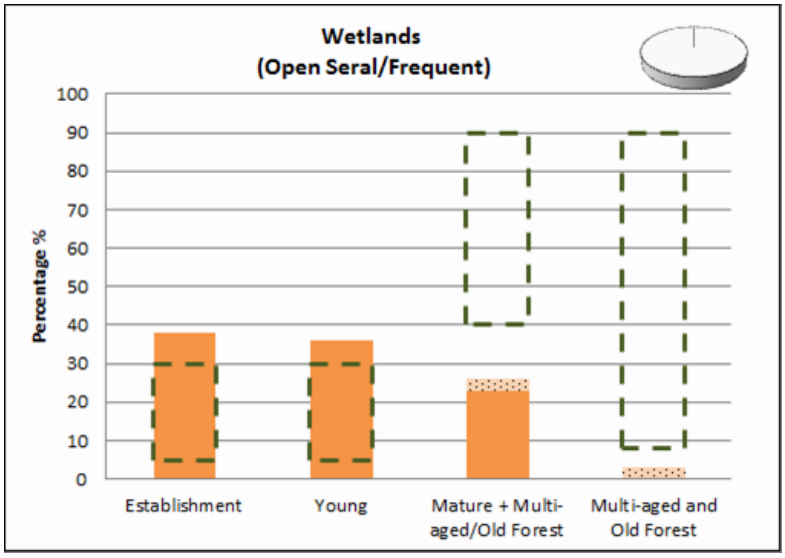

In **Tolerant Mixedwood Slopes,** development classes are close to the desired range except for the multi-aged and old forest class. Partial harvesting and other forestry prescriptions that maintain forest cover as well as reduce impacts on slope stability should be used in this element. Pre-commercial thinning and crop tree release in young stands can be used to favour late successional species.



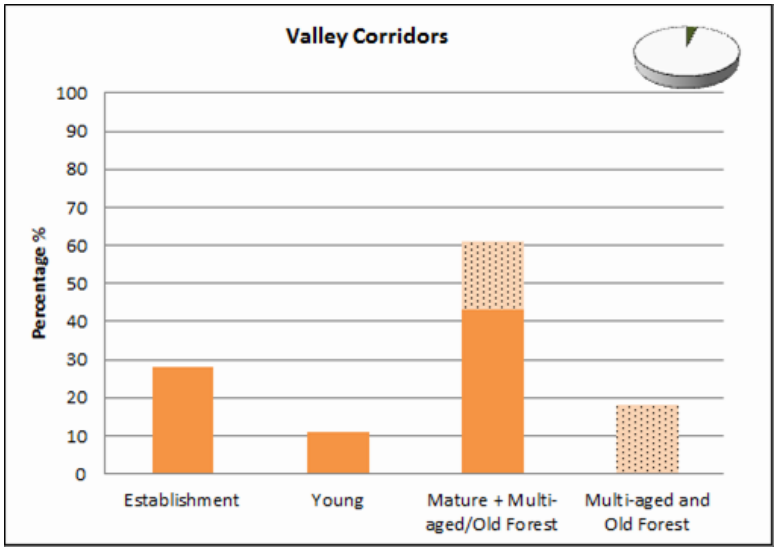

The small **Floodplain** patch element is often associated with the Valley Corridors and the Wetlands elements and provides a habitat interface with the hydrological system. The small size and limited distribution of this element make its composition sensitive to local level disturbance. Forest management should be minimal.



The **Wetlands** element is variably composed of forest, interspersed with woodlands and open wetlands. Disturbances are often patchy, reflecting the diverse structure. The relatively high amount of establishment and young may reflect height growth limitations in poor sites, as well as past harvesting. Some thinning opportunities may exist, as well as potential for small patch harvesting following natural boundaries.




The **Valley Corridors** element includes parts of several elements and does not have a specific disturbance regime or composition target. The current dominance of mature conditions should enhance forest cohesion and support connectivity functions along this linear element feature.




## Summary of Parts 1 and 2

This ends the first two parts of this report, which are available online to anyone who wants to view them. The intent was for the first part to provide a general overview of the ecodistrict for members of the public. The second part was designed for woodland owners to show how landscape ideas, such as elements, can be applied at the woodlot level.

The third part of the report, which includes more detailed information, maps, appendices, glossary, and literature citations, is designed for forest planners, managers, ecologists, analysts, and interested woodland owners.

## Glossary A: Terms in Parts 1 and 2

| | |
|---|---|
| Biodiversity | The diversity of plants, animals, and other living organisms, in all their forms and level of organization, including genes, species, ecosystems, and the evolutionary and functional process that link them. |
| Canopy | The uppermost continuous layer of branches and foliage in a stand of trees. |
| Climax forest community | A relatively stable and self-perpetuating forest community condition that maintains itself (more or less) until stand-level disturbance causes a return to an earlier successional stage. The final stage of natural succession for its environment. |
| Climax vegetation | A forest or non-forest community that represents the final stage of natural succession for its environment. |
| Coarse filter approach | A habitat-based approach to conserving biodiversity by maintaining a natural diversity of structures within stands, and representation of ecosystems across landscapes. The intent is to meet the habitat requirements of most native species over time. Usually combined with a fine filter approach to conserve specific rare species and ecosystems. |
| Composition | The proportion of biological components within a specified unit such as a stand or landscape:<br>**Stand or Species Composition.** The proportion of each plant species in a community or stand. May be expressed as a percentage of the total number, basal area, or volume of all species in that community.<br>**Landscape Composition.** The proportion of each community type within a landscape. Community type may be defined by vegetation type, covertype, seral stage, or development class (age). |
| Connectivity | The way a landscape enables or impedes movement of resources, such as water and animals. |
| Converted | Lands removed from a natural state (e.g. forest) and changed to other uses (e.g. agriculture, urban, settlement, road). |
| Corridor | Corridors are natural linear communities or elements, such as river valleys, that link parts of the ecodistrict. They are a fundamental feature of the "matrix, patch, corridor" concept of landscape structure. |

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| Crown land and Provincial Crown land | Used in these Ecological Landscape Analysis reports to include all land under the administration and control of the Minister of Natural Resources under the Forests Act, Section 3; as well as the lands under the administration and control of the Minister of Environment under the Wilderness Areas Protection Act. Also includes Federal Parks in the accounting of protected area representation. |
| Covertype | Refers to the relative percentage of softwood versus hardwood species in the overstory of a stand. In this guide, covertype classes are:<br>**Softwood:** softwood species compose 75% or more of overstory<br>**Hardwood:** hardwood species compose 75% or more of overstory<br>**Mixedwood:** softwood species composition is between 25% and 75% |
| Development class | The description of the structure of forests as they age and grow (e.g. establishment forest, young forest, mature forest, multi-aged / old forest). |
| Disturbance | An event, either natural or human-induced, that causes a change in the existing condition of an ecological system. |
| Ecodistrict | The third of five levels in the Ecological Land Classification for Nova Scotia Volume 1, and a subdivision of ecoregions. Characterized by distinctive assemblages of relief, geology, landform, and vegetation. Used to define the landscape unit for these Ecological Landscape Analysis reports. |
| Ecological land classification | A classification of lands from an ecological perspective based on factors such as climate, physiography and site conditions. The Ecological Land Classification for Nova Scotia Volume 1 delineates ecosystems at five hierarchical scales: ecozone, ecoregion, ecodistrict, ecosection, and ecosite. |
| Ecoregion | The second level of the Ecological Land Classification for Nova Scotia Volume 1, and a subdivision of ecozone. Used to characterize distinctive regional climate as expressed by vegetation. There are nine ecoregions identified in Nova Scotia. |
| Ecosection | The fourth of five levels in the Ecological Land Classification for Nova Scotia Volume 1, and a subdivision of ecodistricts. An ecological land unit with a repeating pattern of landform, soils, and vegetation throughout an ecodistrict. |
| Ecosite | The fifth of five levels in the Ecological Land Classification for Nova Scotia Volume 1, and a subdivision of ecosections. Characterized by conditions of soil moisture and nutrient regimes. Although not mapped, the Acadian and Maritime Boreal ecosites of the province are fully described in the Forest Ecosystem Classification for Nova Scotia (2010). |

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| Ecosystem | A functional unit consisting of all the living organisms (plants, animals, and microbes) in a given area, and all the non-living physical and chemical factors of their environment, linked together through nutrient cycling and energy flow. An ecosystem can be of any size – a log, pond, field, forest, or the Earth's biosphere – but it always functions as a whole unit. Ecosystems are commonly described according to the major type of vegetation, such as a forest ecosystem, old-growth ecosystem, or range ecosystem. Can also refer to units mapped in the DNR Ecological Land Classification system. |
| Element | A landscape ecosystem containing characteristic site conditions that support similar potential vegetation and successional processes. Elements were mapped by combining ecosections with similar climax vegetation and natural disturbance interpretations. Depending on their role in the ecosystem, elements may be described as matrix, patch or corridor. |
| Endangered species | A wildlife species facing imminent extirpation or extinction. A species listed as endangered under the federal or Nova Scotia endangered species legislation (NS Endangered Species Act or federal Species at Risk Act). |
| Even-aged | A forest, stand, or vegetation type in which relatively small age differences exist between individual trees. Typically results from stand-initiating disturbance. |
| Extinct species | A species that no longer exists. A species declared extinct under federal or Nova Scotia endangered species legislation (NS Endangered Species Act or federal SARA). |
| Extirpated species | A species that no longer exists in the wild in Nova Scotia but exists in the wild outside the province. A species declared extirpated under federal or Nova Scotia endangered species legislation (Nova Scotia Species at Risk Act or federal SARA). |
| Forest management | The practical application of scientific, economic, and social principles to the administration and working of a forest for specified objectives. Particularly, that branch of forestry concerned with the overall administrative, economic, legal, and social aspects and with the essentially scientific and technical aspects, especially silviculture, protection, and forest regulation. |
| Frequent stand initiating | Disturbances usually occur more frequently than the average lifespan of the dominant species and are of sufficient intensity to destroy most of the existing trees, promoting a new forest within relatively short periods of time. |

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| Gap replacement | An absence of stand-initiating disturbances supports the development of a dominant overstory that is sustained through dynamic processes of canopy gap formation, understory development, and overstory recruitment. Gap formation ranges from individual tree mortality to periodic gap formation events that are rarely of a stand-initiating intensity. |
| Habitat | The place where an organism lives and/or the conditions of that environment including the soil, vegetation, water, and food. |
| Impact assessment | A study of the potential future effects of resource development on other resources and on social, economic, and/or environmental conditions. |
| Infrequent stand initiating | The time between stand-initiating disturbances is usually longer than the average longevity of dominant species, thereby supporting processes of canopy gap formation and understory development in mature forests. |
| Inherent conditions | Refers to the natural condition of ecosystems based on their enduring physical features. This is the potential condition expected in the absence of human influence. |
| Integrated Resource Management (IRM) | A decision-making process whereby all resources are identified, assessed, and compared before land use or resource management decisions are made. The decisions themselves, whether to approve a plan or carry out an action on the ground, may be either multiple or single use in a given area. The application of integrated resource management results in a regional mosaic of land uses and resource priorities which reflect the optimal allocation and scheduling of resource uses. |
| Land capability (LC) | LC values represent the maximum potential stand productivity ($m^3$/ha/yr) under natural conditions. |
| Landform | A landscape unit that denotes origin and shape, such as a floodplain, river terrace, or drumlin. |
| Landscape | An expanse of natural area, comprising landforms, land cover, habitats, and natural and human-made features that, taken together, form a composite. May range in scale from a few hectares to large tracts of many square kilometres in extent. |
| Matrix | A widespread vegetation forest community which dominates the landscape and forms the background in which other smaller scale communities (patches) occur. The most connected or continuous vegetation type within the landscape, typically the dominant element. (Matrix is a fundamental feature of the “matrix, patch, corridor” concept of landscape structure.) |

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| Mature forest | A development class within the sequence of: 1) forest establishment; 2) young forest; 3) mature forest; and 4) multi-aged and old forest. Mature forests include multi-aged and old forest. Forests are typically taller than 11 metres, have an upper canopy fully differentiated into dominance classes, and regularly produce seed crops. Mature forests may develop over long periods, transitioning from early competitive stages where canopy gaps from tree mortality soon close, to later stages where openings persist and understories develop to produce multi-aged and old forest. |
| Natural disturbance | A natural force that causes significant change in forest stand structure and/or composition such as fire, wind, flood, insect damage, or disease. |
| Natural disturbance regimes | The patterns (frequency, intensity, and extent) of fire, insects, wind, landslides, and other natural processes in an area. Natural disturbances inherently influence the arrangement of forested ecosystems and their biodiversity on a given landscape. Three disturbance regimes recognized in Nova Scotia are:<br>**Frequent:** Disturbances which result in the rapid mortality of an existing stand and the establishment of a new stand of relatively even age. The time interval between stand-initiating events typically occurs more frequently than the longevity of the climax species that would occupy the site – therefore, evidence of gap dynamics and understory recruitment is usually absent. This regime results in the establishment and perpetuation of early to mid-successional vegetation types.<br>**Infrequent:** Stand-initiating disturbances which result in the rapid mortality of an existing stand and the establishment of a new stand of relatively even-age, but the time interval between disturbance events is normally longer than the average longevity of the dominant species – allowing gap dynamics and understory recruitment to evolve and become evident (eventually creating uneven-aged stands). This regime generally leads to the establishment and/or perpetuation of mid to late successional vegetation types.<br>**Gap replacement:** Stand-initiating disturbances are rare. Instead, disturbances are characterized by gap and small patch mortality, followed by understory recruitment, resulting in stands with multiple age classes. This regime generally leads to the establishment and/or perpetuation of late successional vegetation types. |
| Old growth | Climax forests in the late stage of natural succession, the shifting mosaic phase, marked by mature canopy processes of gap formation and recruitment from a developed understory. Typical characteristics include a multi-layered canopy of climax species containing large old trees, decadent wolf trees, and abundant snags and coarse woody debris. In Nova Scotia, stands older than 125 years are classed as old growth. |

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| Patch | A discrete community or element nested within a surrounding landscape, which is often a matrix forest. (Patch is a fundamental feature of the "matrix, patch, corridor" concept of landscape structure.) |
| Reserve | An area of forest land that, by law or policy, is usually not available for resource extraction. Areas of land and water set aside for ecosystem protection, outdoor and tourism values, preservation of rare species, gene pool and wildlife protection (e.g. wilderness areas, parks). |
| Riparian | Refers to area adjacent to or associated with a stream, floodplain, or standing water body. |
| Seral stage | Any stage of succession of an ecosystem from a disturbed, unvegetated state to a climax plant community. Seral stage describes the tree species composition of a forest within the context of successional development. |
| Species | A group of closely related organisms that are capable of interbreeding, and which are reproductively isolated from other groups of organisms; the basic unit of biological classification. |
| Species at risk | Legally recognized designation for species at federal and/or provincial levels that reflects varying levels of threats to wildlife populations. The four categories of risk are extirpated, endangered, threatened, and species of special concern. |
| Succession | An orderly process of vegetation community development that over time involves changes in species structure and processes. |
| Tolerance | The ability of an organism or biological process to subsist under a given set of environmental conditions. The range of these conditions, representing its limits of tolerance, is termed its ecological amplitude. For trees, the tolerance of most practical importance is their ability to grow satisfactorily in the shade of, and in competition with, other trees. |
| Vulnerable species | A species of special concern due to characteristics that make it particularly sensitive to human activities or natural activities or natural events. May also be referred to as "species of special concern." A species declared vulnerable under the federal or Nova Scotia endangered species legislation (NS Endangered Species Act or federal SARA). |
| Wilderness area | A part of the provincial landbase designated under the Wilderness Areas Protection Act (e.g. Canso Barrens). |